



HF-SERIES CONTROLLER



Reference Manual



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HF-Series Reference Manual

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REFERENCES

CONVENTIONS

This manual uses the following conventions:

“User” or “Operator” refers to anyone using a Cobalt HF-Series Controller.

“Device” refers to the Cobalt HF-Series Controller.

“You” refers to the System Administrator or Technical Support person using this manual to install, mount, operate, maintain or troubleshoot a Cobalt HF-Series Controller.

Cobalt C-Series, HF-Series and UHF-Series RFID Controllers are referred to as Cobalt Controllers, or just “the Controller”.

In addition, the terms “Subnet Node Number”, “Node ID” and “Controller ID” are used interchangeably.

REFERENCE DOCUMENTATION

The documentation related to the HF-Series Controller management is available on the specific product page at the website:

www.automation.datalogic.com

SERVICES AND SUPPORT

Datalogic provides several services as well as technical support through its website. Log on to **www.automation.datalogic.com** and click on the links indicated for further information including:

- **PRODUCTS**

Search through the links to arrive at your product page which describes specific Info, Features, Applications, Models, Accessories, and Downloads including:

- **Cobalt Dashboard™**: a Windows-based utility program, which allows system testing, monitoring, and configuration using a PC. It provides Serial (RS232 or USB) and Ethernet interface configuration.
- **C-Macro Builder™**: an easy to use GUI-driven utility for Windows. This software tool allows users with minimal programming experience to “build” their own macro programs (which are stored internally on and executed directly by Cobalt RFID Controllers).

- **SERVICE**

- **Overview** - Warranty Extensions and Maintenance Agreements
- **Sales Network** - Listing of Subsidiaries, Repair Centers, Partners
- **Helpdesk**
- **Material Return Authorization**

REGULATORY AND COMPLIANCE NOTICES

This product is intended to be installed by Qualified Personnel only.

This product must not be used in explosive environments.

Only connect Ethernet and dataport connections to a network which has routing only within the plant or building and no routing outside the plant or building.

RADIO COMPLIANCE

ENGLISH

Contact the competent authority responsible for the management of radio frequency devices of your country to verify any possible restrictions or licenses required.

For further information, refer to the web site:

<http://ec.europa.eu/enterprise/sectors/rtte/>

ITALIANO

Prendi contatto con l'autorità competente per la gestione degli apparati a radio frequenza del tuo paese, per verificare eventuali restrizioni o licenze.

Ulteriori informazioni sono disponibili sul sito:

<http://ec.europa.eu/enterprise/sectors/rtte/>

FRANÇAIS

Contactez l'autorité compétente en la gestion des appareils à radio fréquence de votre pays pour vérifier d'éventuelles restrictions ou licences. Pour tout renseignement vous pouvez vous adresser au site web:

<http://ec.europa.eu/enterprise/sectors/rtte/>

DEUTSCH

Wenden Sie sich an die für Radiofrequenzgeräte zuständige Behörde Ihres Landes, um zu prüfen ob es Einschränkungen gibt, oder eine Lizenz erforderlich ist.

Weitere Informationen finden Sie auf der Web Seite:

<http://ec.europa.eu/enterprise/sectors/rtte/>

ESPAÑOL

Contacta la autoridad competente para la gestión de los dispositivos de radio frecuencia de tu país, para verificar cualesquiera restricciones o licencias posibles requerida.

Además se puede encontrar mas información en el sitio:

Web: <http://ec.europa.eu/enterprise/sectors/rtte/>



FCC COMPLIANCE

Modifications or changes to this equipment without the expressed written approval of Datalogic could void the authority to use the equipment.

This device complies with PART 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference which may cause undesired operation.

FCC ID E36-0001: for HF-CNTL-232, HF-CNTL-485, HF-CNTL-IND models

FCC ID E36-0002: for HF-CNTL-PBS, HF-CNTL-DNT, HF-CNTL-PNT models

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

POWER SUPPLY

This product is intended to be installed by Qualified Personnel only.

This device is intended to be supplied by a UL Listed or CSA Certified Power Unit with «Class 2» or LPS power source.

GENERAL VIEW

RS232 Models

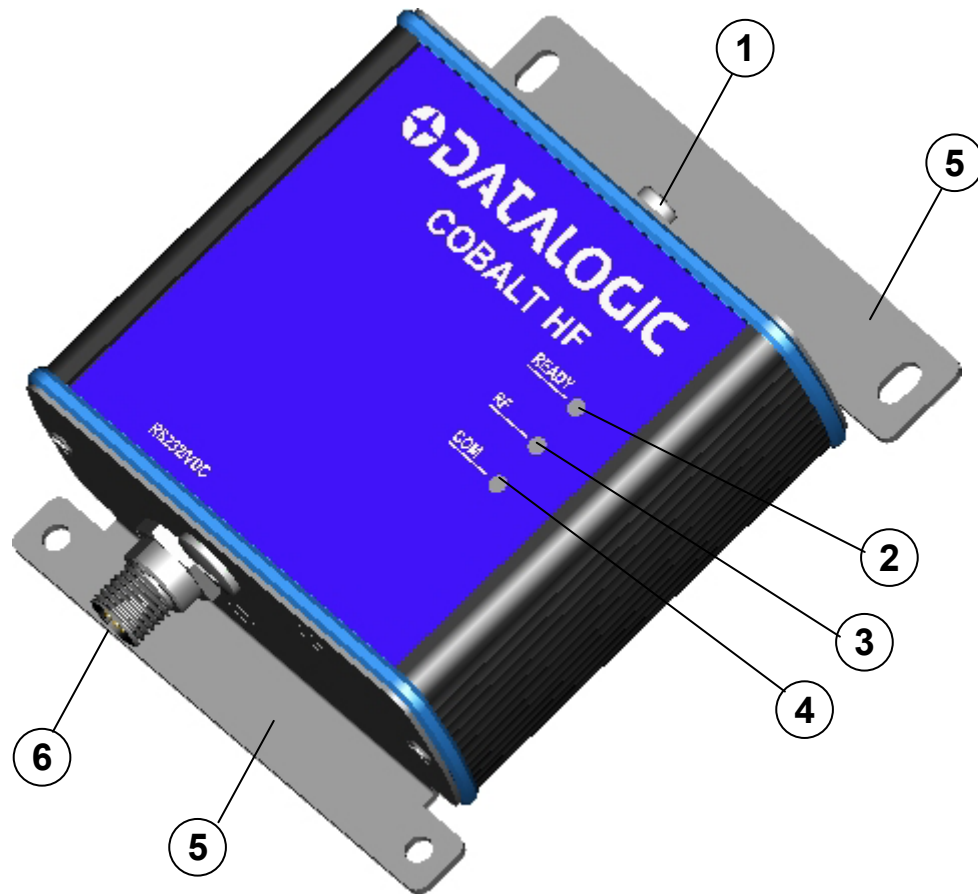


Figure A

① HF Antenna Connector

② Ready LED

③ RF LED

④ COM LED

⑤ Mounting Bracket

⑥ Host (RS232) and Power Connector

RS485 Models

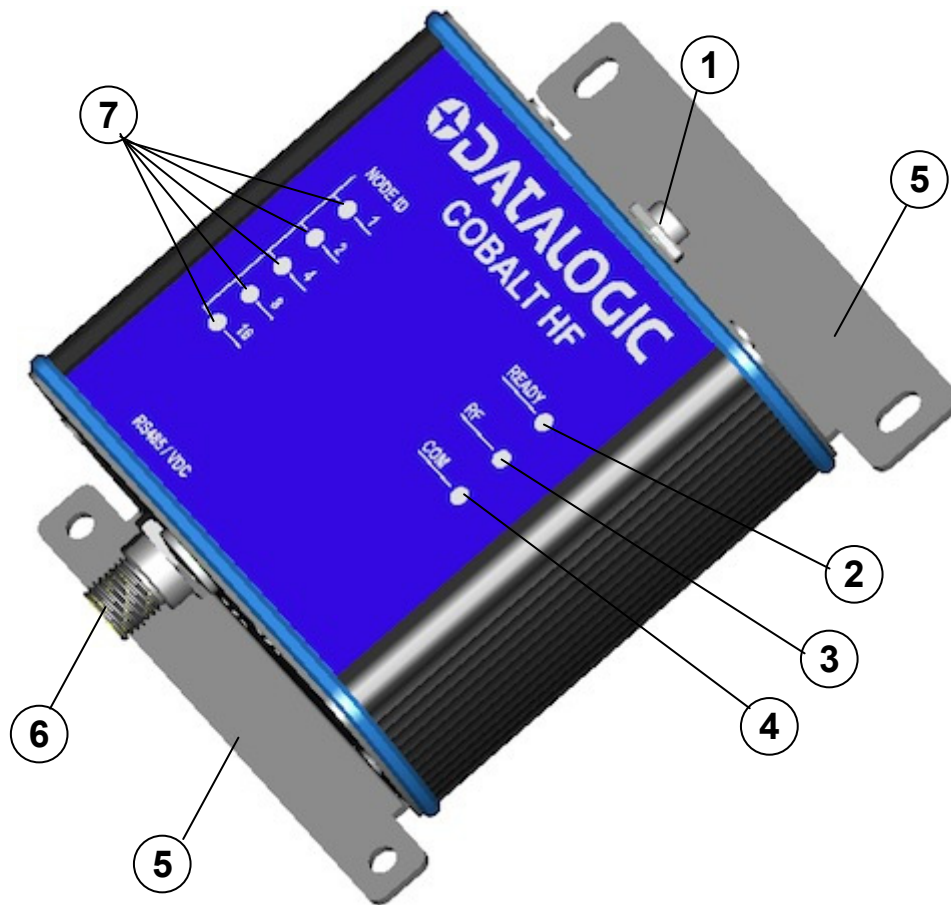


Figure B

- | | |
|------------------------|------------------------------------|
| 1 HF Antenna Connector | 4 COM LED |
| 2 Ready LED | 5 Mounting Bracket |
| 3 RF LED | 6 Host (RS485) and Power Connector |
| | 7 Node ID LEDs |

IND Models

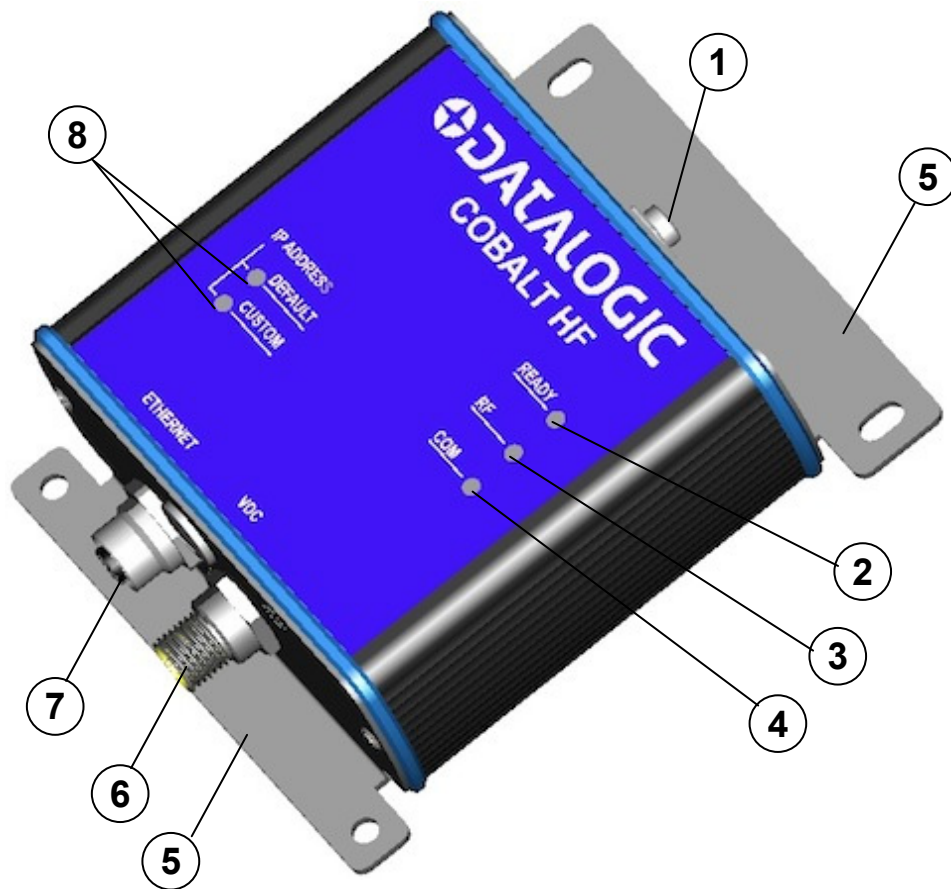


Figure C

① HF Antenna Connector

② Ready LED

③ RF LED

④ COM LED

⑤ Mounting Bracket

⑥ Power Connector

⑦ Host (Ethernet) Connector

⑧ IP Address Status LEDs

DNT Models

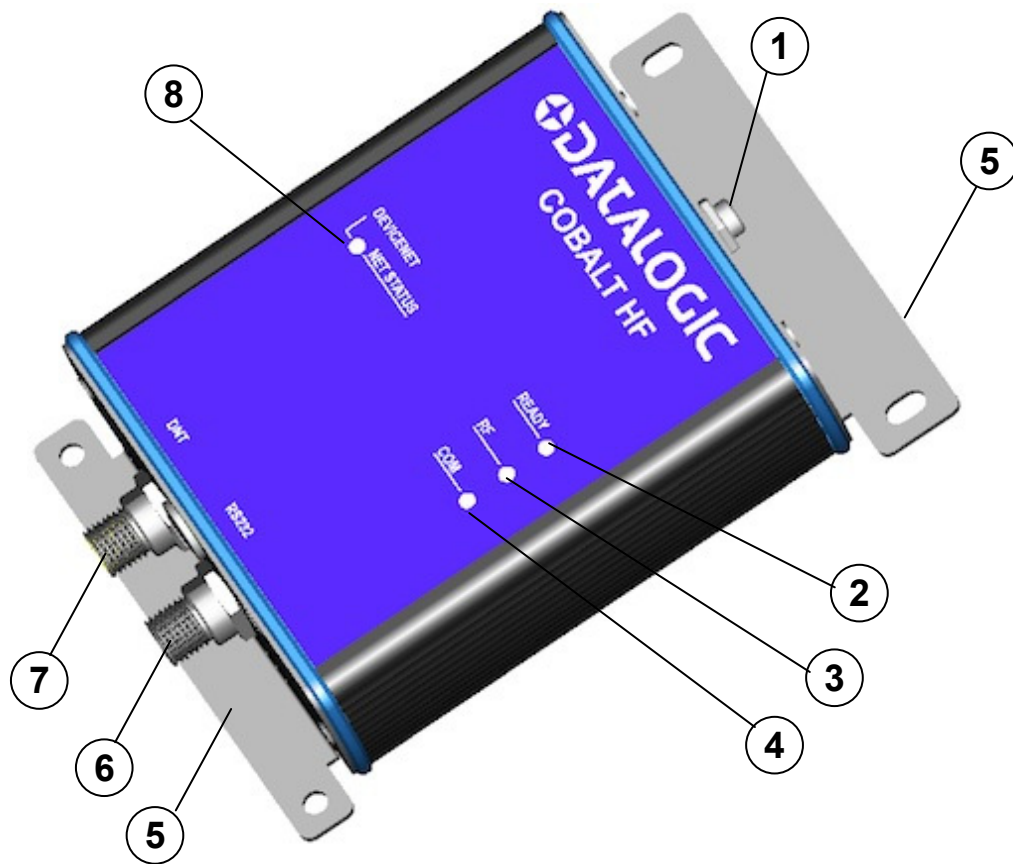


Figure D

- | | |
|------------------------|--|
| 1 HF Antenna Connector | 5 Mounting Bracket |
| 2 Ready LED | 6 RS232 Configuration Connector |
| 3 RF LED | 7 Host (DeviceNet) and Power Connector |
| 4 COM LED | 8 DeviceNet Status LED |

PBS Models

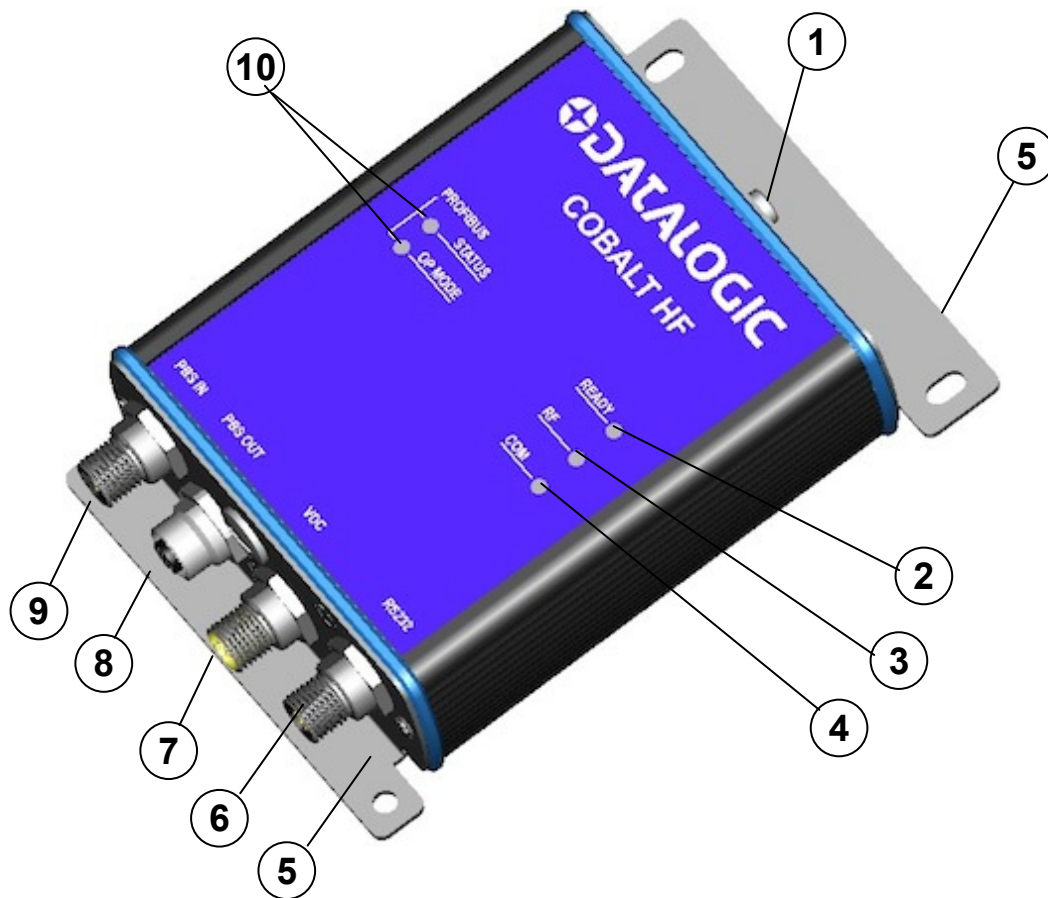


Figure E

- | | |
|------------------------|---------------------------------|
| ① HF Antenna Connector | ⑥ RS232 Configuration Connector |
| ② Ready LED | ⑦ Power Connector |
| ③ RF LED | ⑧ Host (Profibus Out) Connector |
| ④ COM LED | ⑨ Host (Profibus In) Connector |
| ⑤ Mounting Bracket | ⑩ Profibus Status LEDs |

PNT Models

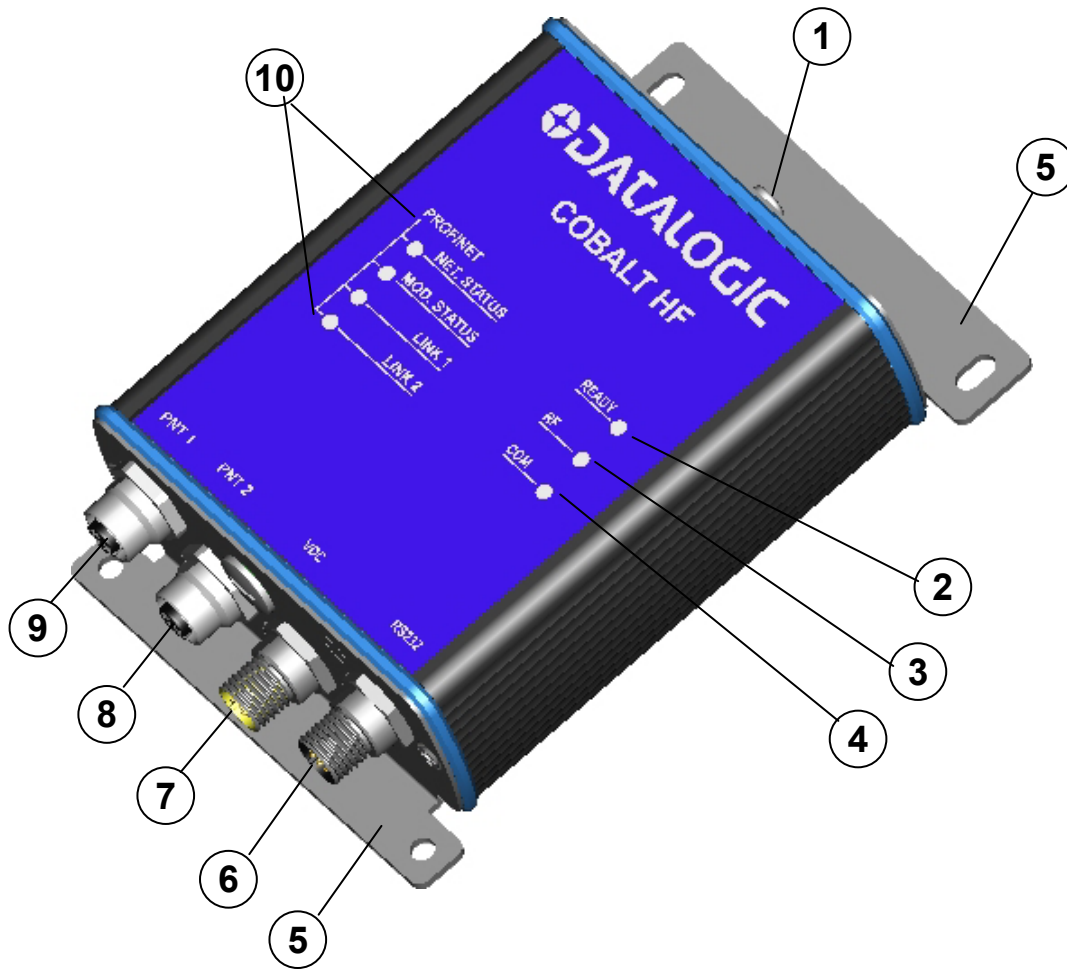
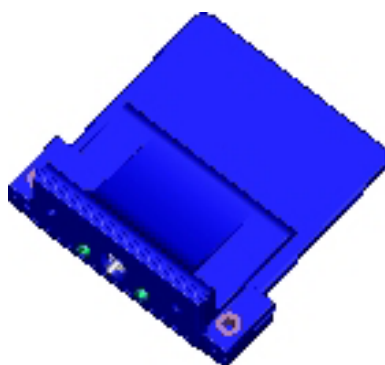


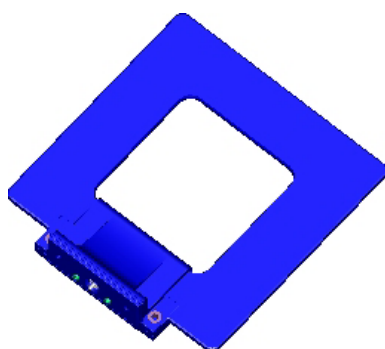
Figure F

- | | |
|------------------------|---------------------------------|
| ① HF Antenna Connector | ⑥ RS232 Configuration Connector |
| ② Ready LED | ⑦ Power Connector |
| ③ RF LED | ⑧ Profinet 2 Connector |
| ④ COM LED | ⑨ Profinet 1 Connector |
| ⑤ Mounting Bracket | ⑩ Profinet Status LEDs |

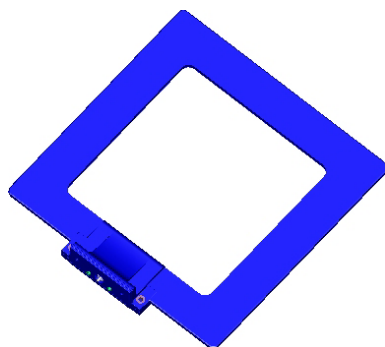
HF-ANT-1010-01



HF-ANT-2020-01



HF-ANT-3030-01



HF-ANT-0750-01

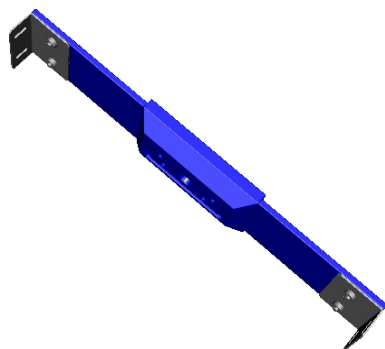


Figure G

1 OVERVIEW

1.1 INTRODUCTION

Welcome to the **Cobalt HF-Series RFID Controllers Reference Manual**. This manual will assist you in the installation, configuration and operation of the Cobalt HF-Series family of RFID controllers.

The Cobalt HF-Series is a complete line of feature-rich, passive, high frequency, read/write Radio-Frequency Identification devices that provide RFID data collection and control solutions to shop floor, item-level tracking and material handling applications. Cobalt HF controllers are designed to be compact, rugged and reliable, in order to meet and exceed the requirements of the industrial automation industry. For an overview of RFID operating principles and tags see Appendix A.

1.2 HF-SERIES FEATURES

- High performance, industrial, multi-protocol RFID controller
- Available support for multiple communication protocols: Subnet16™, standard TCP/IP, Ethernet/IP, MODBUS TCP, Profibus-DP-V1 and Profinet IO
- Supports multiple interface connections: RS232, RS485, Ethernet, DeviceNet, Profibus; Profinet
- Reads/Writes ISO 14443A and ISO 15693 compliant RFID tags
- Compatible with HMS, LRP and T-Series RFID tags from Datalogic
- Supports Datalogic's ABx Fast & CBx RFID command protocols
- Operates at the internationally recognized ISM frequency of 13.56 MHz
- Housed in rugged IP65 rated enclosure
- LED status indicators display READY status, COM activity, RF activity, and depending on the model, Subnet16 Node ID, DeviceNet, Profibus or Profinet network status
- Auto configurable and software programmable, contains flash memory for firmware upgrades and internal configuration storage.

1.3 ABOUT THIS MANUAL

This manual provides guidelines and instructions for installing, configuring and operating HF-Series Controllers.

This document does NOT include explicit details regarding the HF-Series Controller commands. Specific RFID command related information such as: the process of issuing commands from a host PC or Programmable Logic Controller (PLC) to the HF-Series Controller is available in the CBx Command Protocol – Reference Manual, which is available at www.automation.datalogic.com.

1.3.1 Who Should Read This Manual?

This manual should be read by those who will be installing, configuring and operating the Controller. This may include the following people:

- Hardware Installers
- System Integrators
- Project Managers
- IT Personnel
- System and Database Administrators
- Software Application Engineers
- Service and Maintenance Engineers

1.3.2 HEX Notation

Throughout this manual, numbers expressed in Hexadecimal notation are prefaced with "0x". For example, the number "10" in decimal is expressed as "0x0A" in hexadecimal.

1.4 MODELS AND ACCESSORIES

Datalogic Automation designs, manufactures and distributes a wide range of RFID equipment including RFID controllers, network interface modules (Gateways and Hubs), RFID tags and the cables needed to make it all work.

Listed here are the products and accessories relative to the HF-Series controllers. For a complete list of products and accessories relative to the Subnet16™ Gateway see the Gateway Reference Manual.

To purchase any of the Datalogic Automation products listed below contact your Datalogic Automation distributor or visit our Web site: <http://www.automation.datalogic.com>.

Name	Description	Part Number
HF-Series Controllers		
HF-CNTL-232-02	Cobalt HF RFID Controller - RS232	970327002
HF-CNTL-232-12	Cobalt HF RFID Controller - RS232 w I/O	970327014
HF-CNTL-485-02	Cobalt HF RFID Controller - RS485 Subnet16™	970327006
HF-CNTL-485-12	Cobalt HF RFID Controller - RS485 Subnet16™ w I/O	970327015
HF-CNTL-IND-02	Cobalt HF RFID Controller - Industrial Ethernet	970327010
HF-CNTL-IND-12	Cobalt HF RFID Controller - Industrial Ethernet w I/O	970327016
HF-CNTL-DNT-02	Cobalt HF RFID Controller - DeviceNet	970327008
HF-CNTL-PBS-02	Cobalt HF RFID Controller - Profibus	970327011
HF-CNTL-PNT-02	Cobalt HF RFID Controller - Profinet	970327017
HF-Series Antennas		
HF-ANT-0750-01	Cobalt HF Antenna 7 x 50 cm	970325001
HF-ANT-1010-01	Cobalt HF Antenna 10 x 10 cm	970325002

Name	Description	Part Number
HF-ANT-2020-01	Cobalt HF Antenna 20 x 20 cm	970325003
HF-ANT-3030-01	Cobalt HF Antenna 30 x 30 cm	970325004
HF-ANT-CBL-07-12	Cobalt HF Remote Antenna kit 7 m	970101127
Cables & Connectors		
CBL-1478	RS232 Cable: M12, DB9-pin, PS wires	970101018
CBL-1480-0.3	Cable: M12, 5-pin, Male/Female, ThinNet, 0.3 m	970101020
CBL-1480-01	Cable: M12, 5-pin, Male/Female, ThinNet, 1 m	970101021
CBL-1480-02	Cable: M12, 5-pin, Male/Female, ThinNet, 2 m	970101022
CBL-1480-05	Cable: M12, 5-pin, Male/Female, ThinNet, 5 m	970101023
CBL-1481-0.2	Cable: M12, 5-pin, Male/Male, ThinNet, 0.2 m (Gateway to Drop-T)	970101027
CBL-1481-01	Cable: M12, 5-pin, Male/Male, ThinNet, 1 m (Gateway to Drop-T)	970101028
CBL-1481-02	Cable: M12, 5-pin, Male/Male, ThinNet 2 m (Gateway to Drop-T)	970101029
CBL-1483-02	Cable: 7/8-16, 5-pin, Male/Female, ThickNet, 2 m	970101037
CBL-1483-05	Cable: 7/8-16, 5-pin, Male/Female, ThickNet, 5 m	970101038
CBL-1494-02	Cable: M12, 5-pin, Female / Bare Wires, ThinNet, 2 m	970101077
CBL-1494-05	Cable: M12, 5-pin, Female / Bare Wires, ThinNet, 5 m	970101078
CBL-1495-05	Cable: 7/8-16, 5-pin, Female / Bare Wires, 5M	970101080
CBL-1498-02	Cable: M12, 5-pin, Male / Bare Wires, ThinNet, 2M	970101084
CBL-1515-05	Industrial Ethernet Cable: M12, RJ45 5 m	970101087
Subnet16™ Ts, Terminators, Connectors		
CBL-1485	Drop-T Connector: 5-pin, 7/8-16 F / M12 F / 7/8-16 M (ThickNet to ThinNet)	970101061
CBL-1486	Drop-T Connector: M12, 5-pin, F/F/M (ThinNet to ThinNet)	970101062
CBL-1487	Field Mountable Connector: M12, 5-pin, Female, Straight	970101063
CBL-1489	Termination Resistor Plug: 7/8-16, 5-pin, Male, (ThickNet)	970101068
CBL-1490	Termination Resistor Plug: M12, 5-pin, Male, (ThinNet)	970101069
CBL-1493	RS232 Connector: M12, 8-pin, Female	970101075
CBL-1496	Plug: Termination Resistor, M12, 5-pin, Female (ThinNet)	970101082
CBL-1497	Plug: Termination Resistor, 7/8-16, 5-pin, Female (ThickNet)	970101083
CBL-1521	Field Mountable Connector: 7/8-16, 5-pin, Female, Straight	970101115
CBL-1526	T Connector: 7/8-16/5P M/F/F (ThickNet to ThickNet)	970101118

1.5 DATALOGIC AUTOMATION RFID TAGS

Datalogic Automation designs and manufactures several lines of RFID tags.

LRP, HMS and T-Series passive read/write RFID tags are specially suited for Datalogic Automation HF RFID Controllers.

Tag Mounting Kits are also available.

2 INSTALLATION

2.1 MECHANICAL DIMENSIONS

2.1.1 RS232 Models

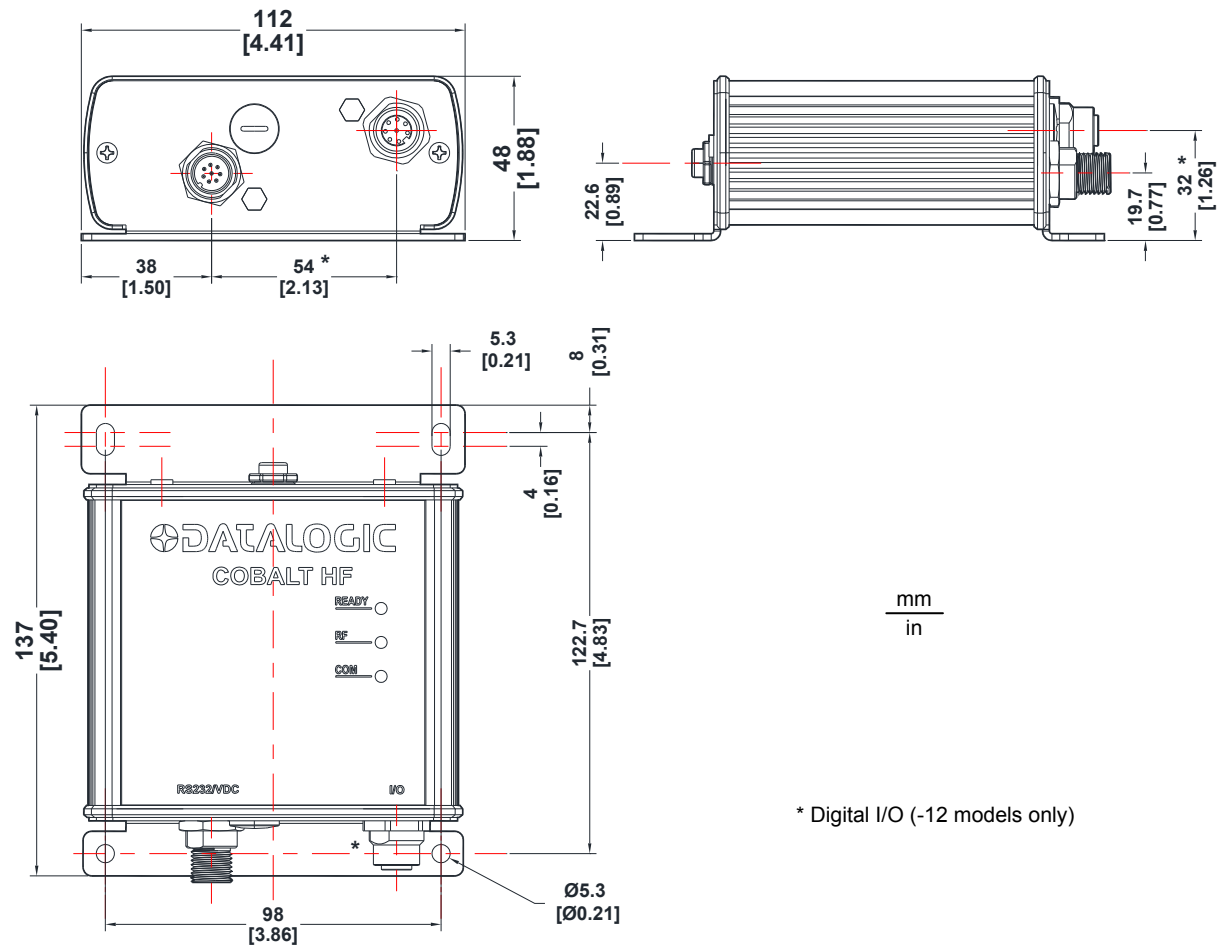


Figure 1 - RS232 Dimensions

2.1.2 RS485 Models

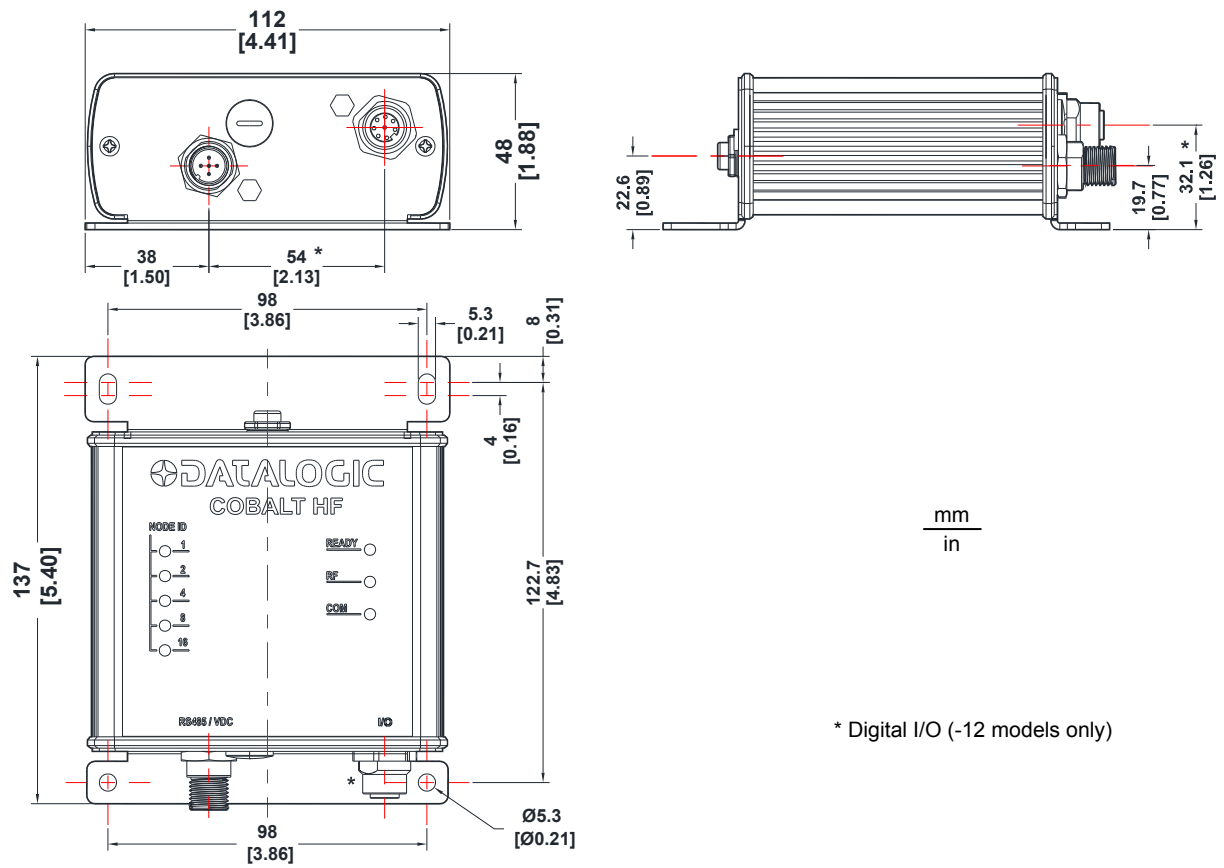


Figure 2 - RS485 Dimensions

2.1.3 IND Models

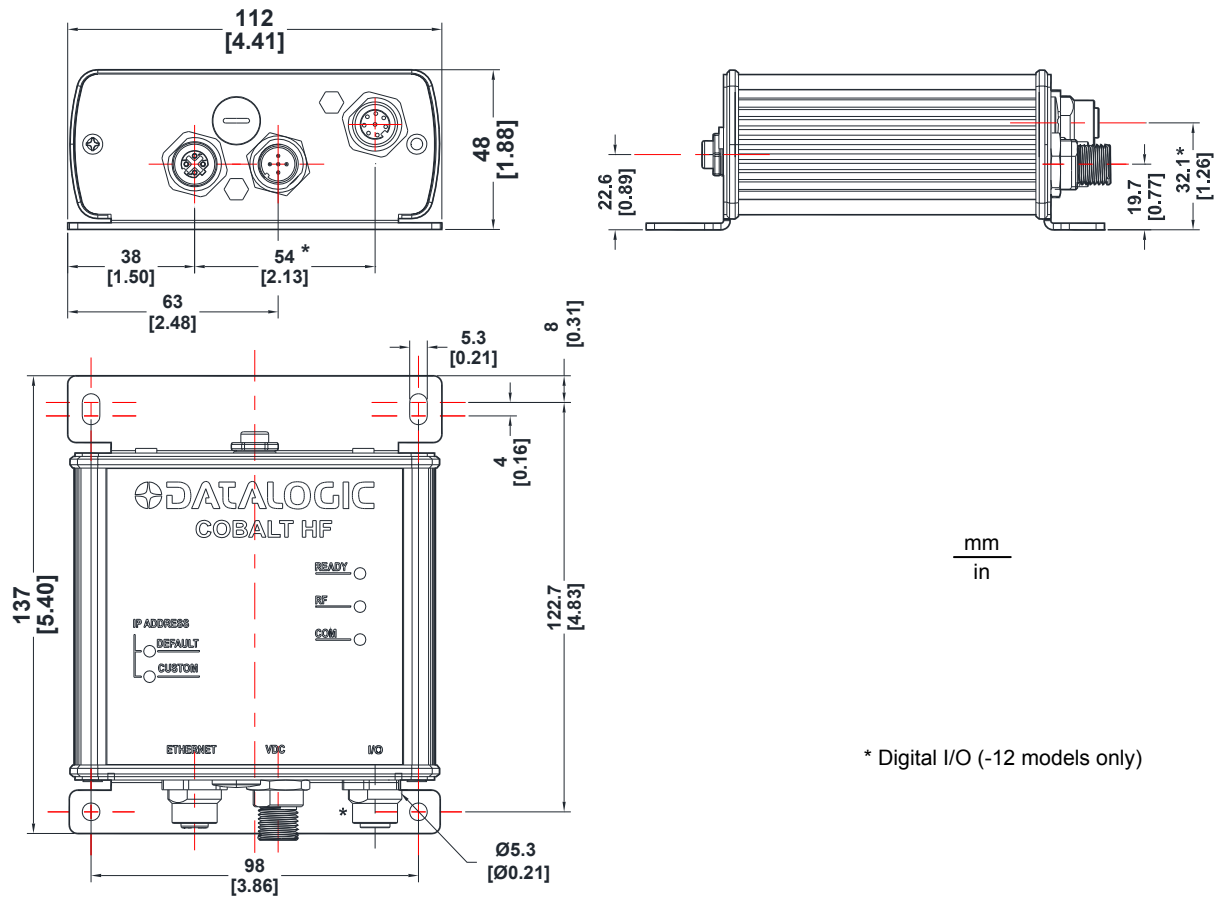


Figure 3 - IND Dimensions

2.1.4 DNT Models

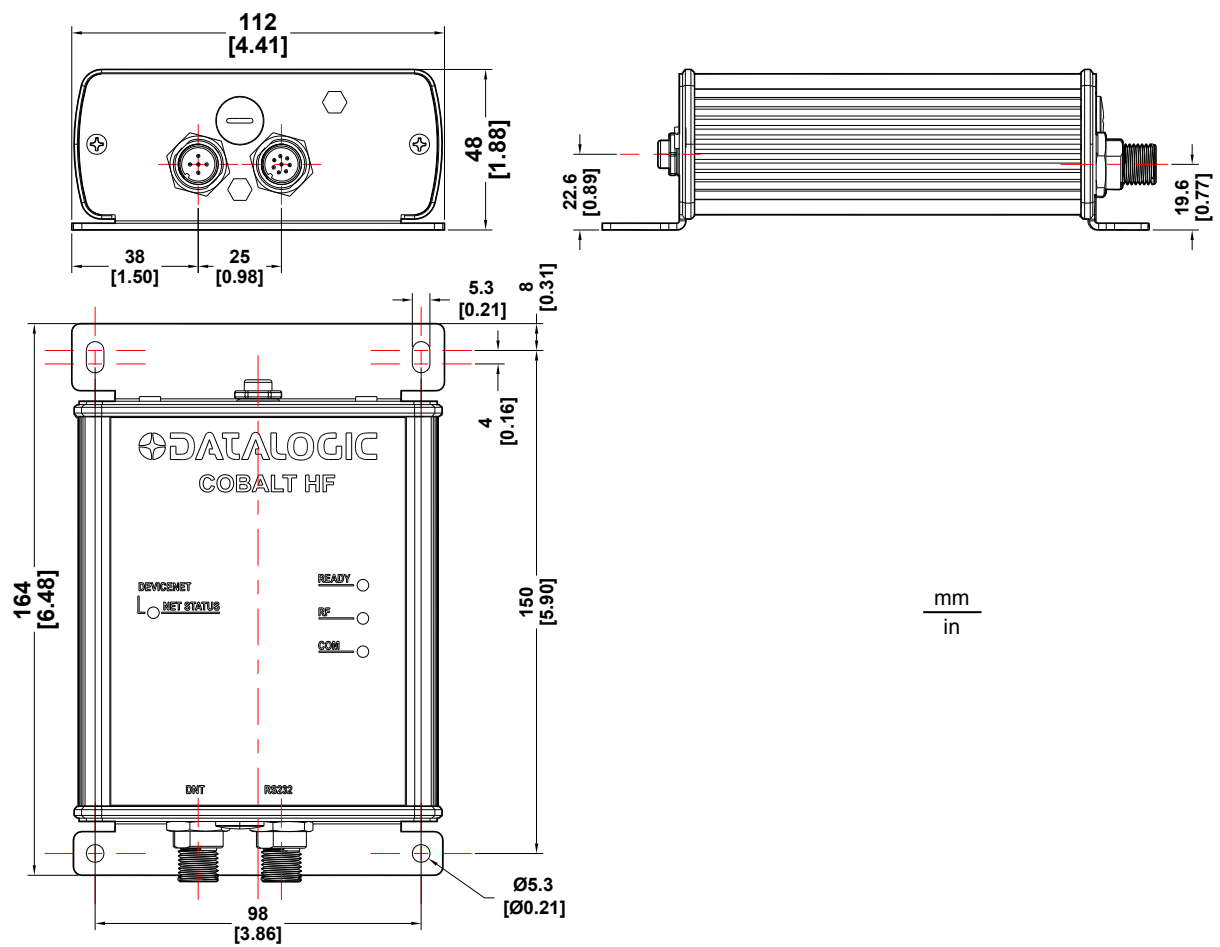
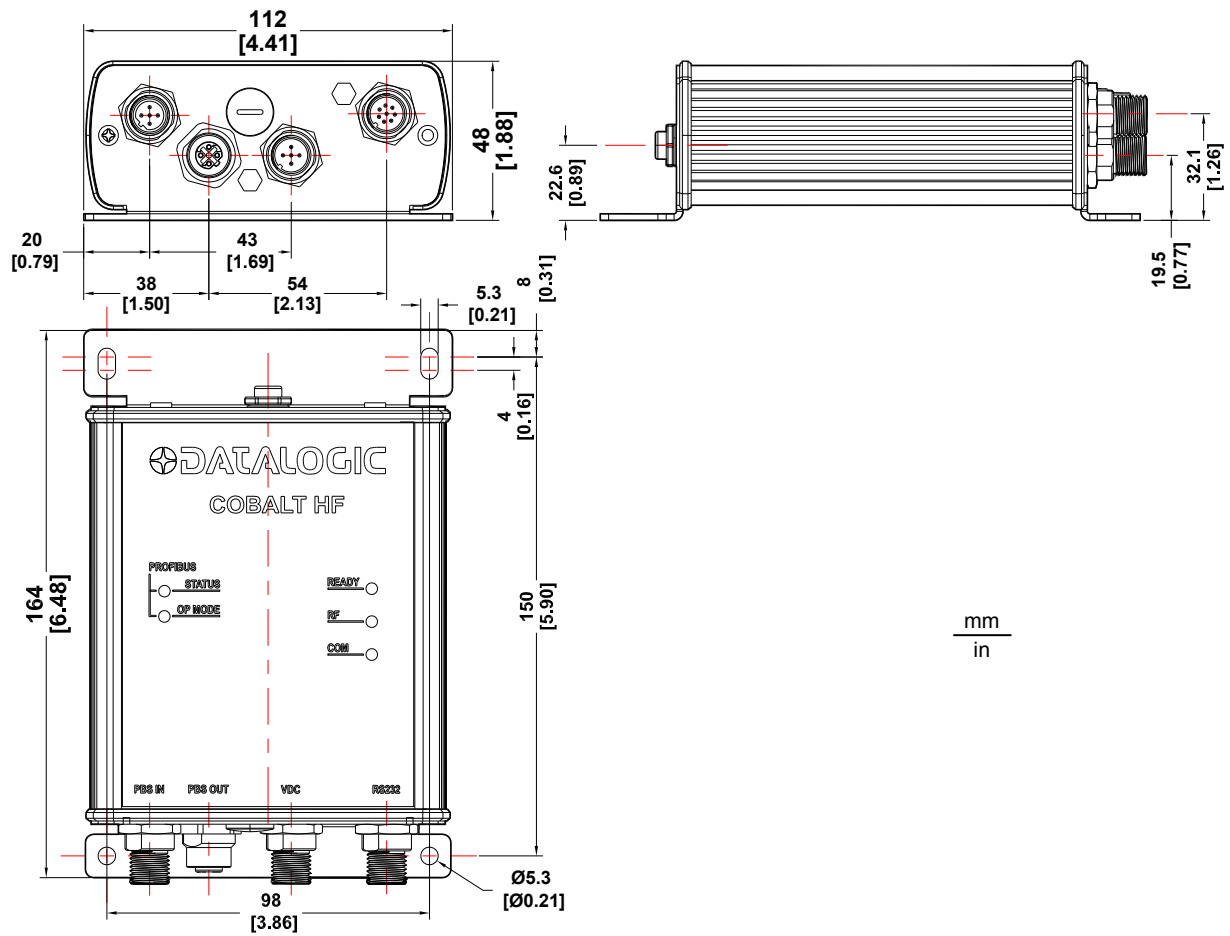


Figure 4 - DNT Dimensions

2.1.5 PBS Models



2.1.6 PNT Models

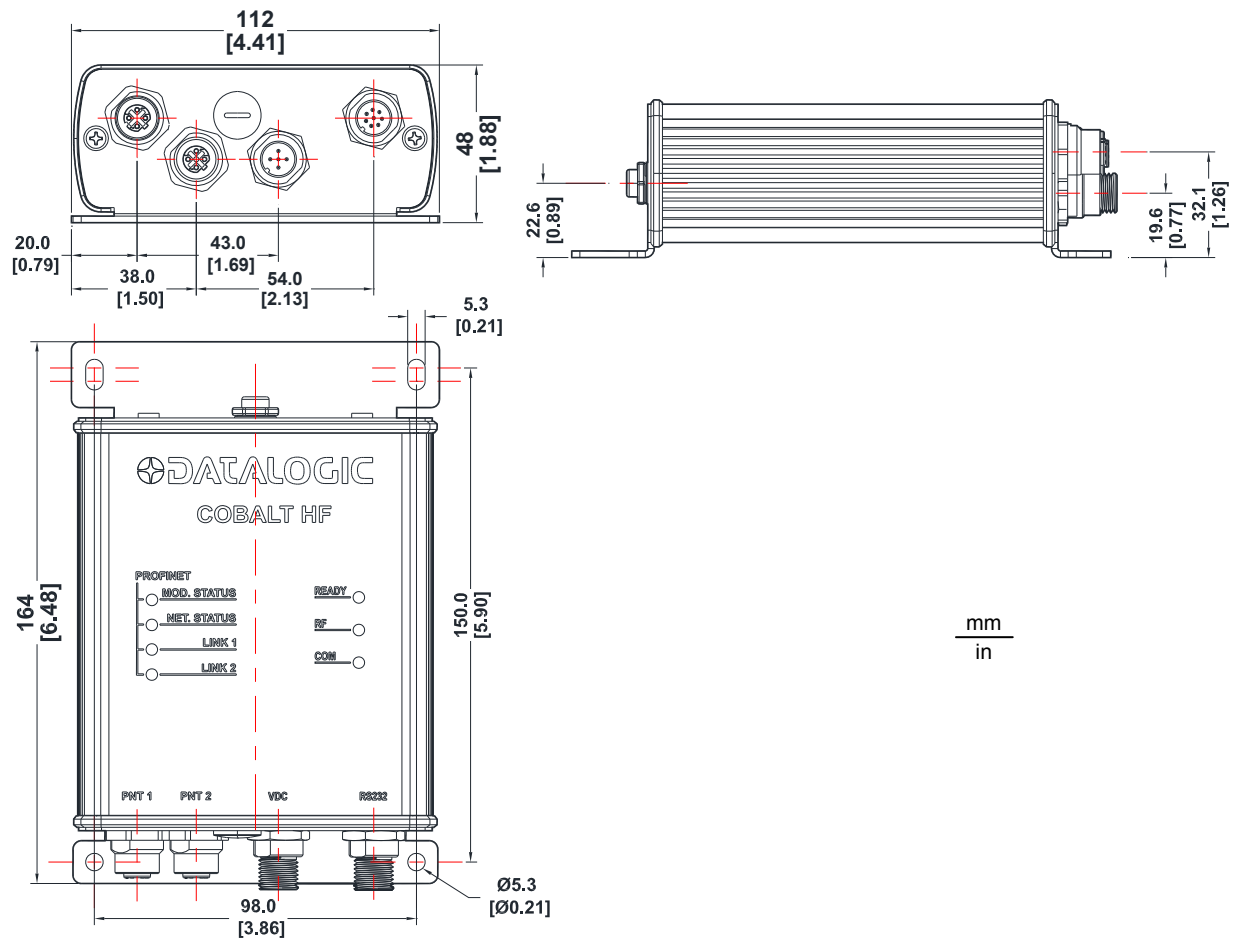


Figure 6 - PNT Dimensions

HF-ANT-1010-01

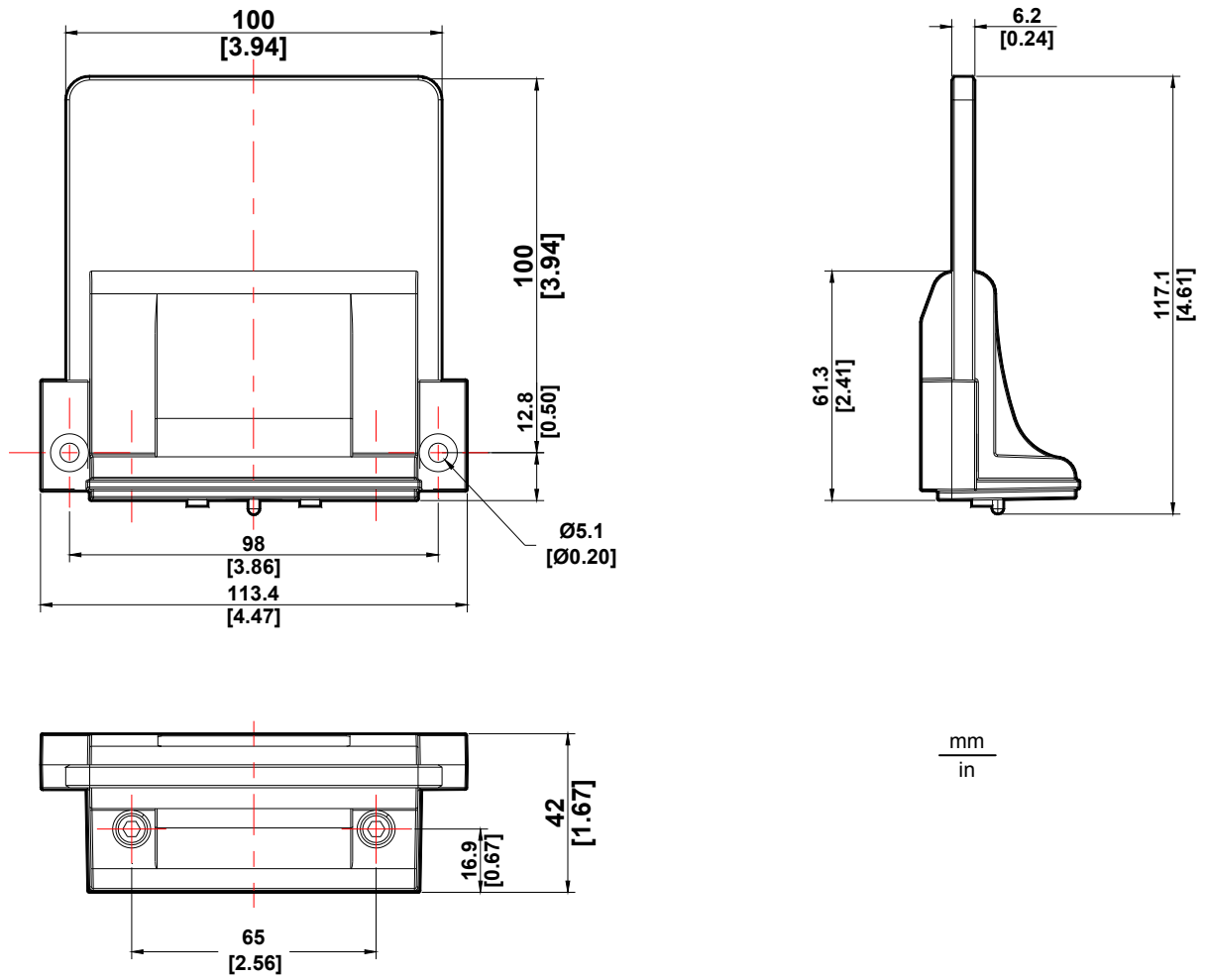


Figure 7 - HF-ANT-1010-01

HF-ANT-2020-01

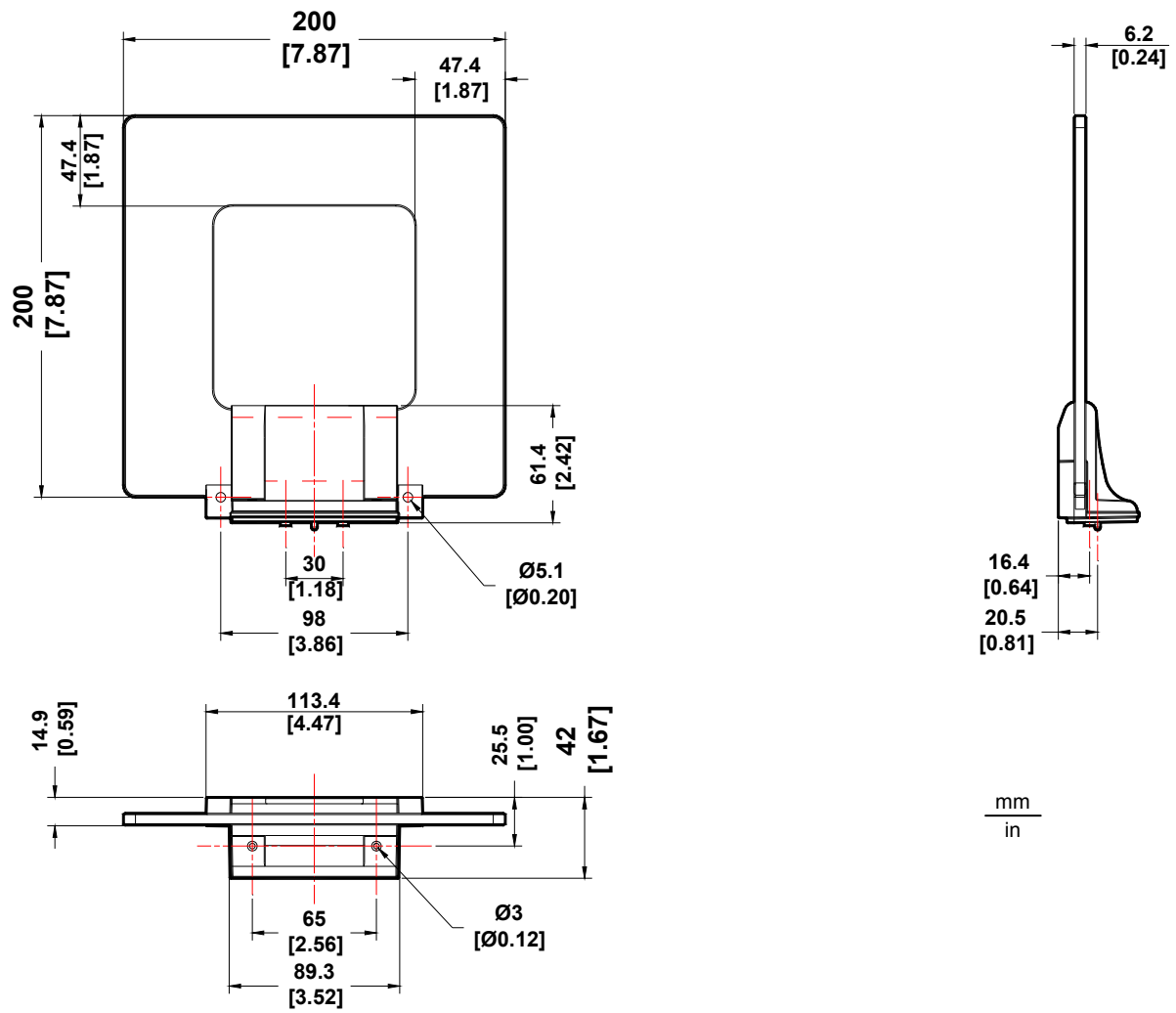


Figure 8 - HF-ANT-2020-01

HF-ANT-3030-01

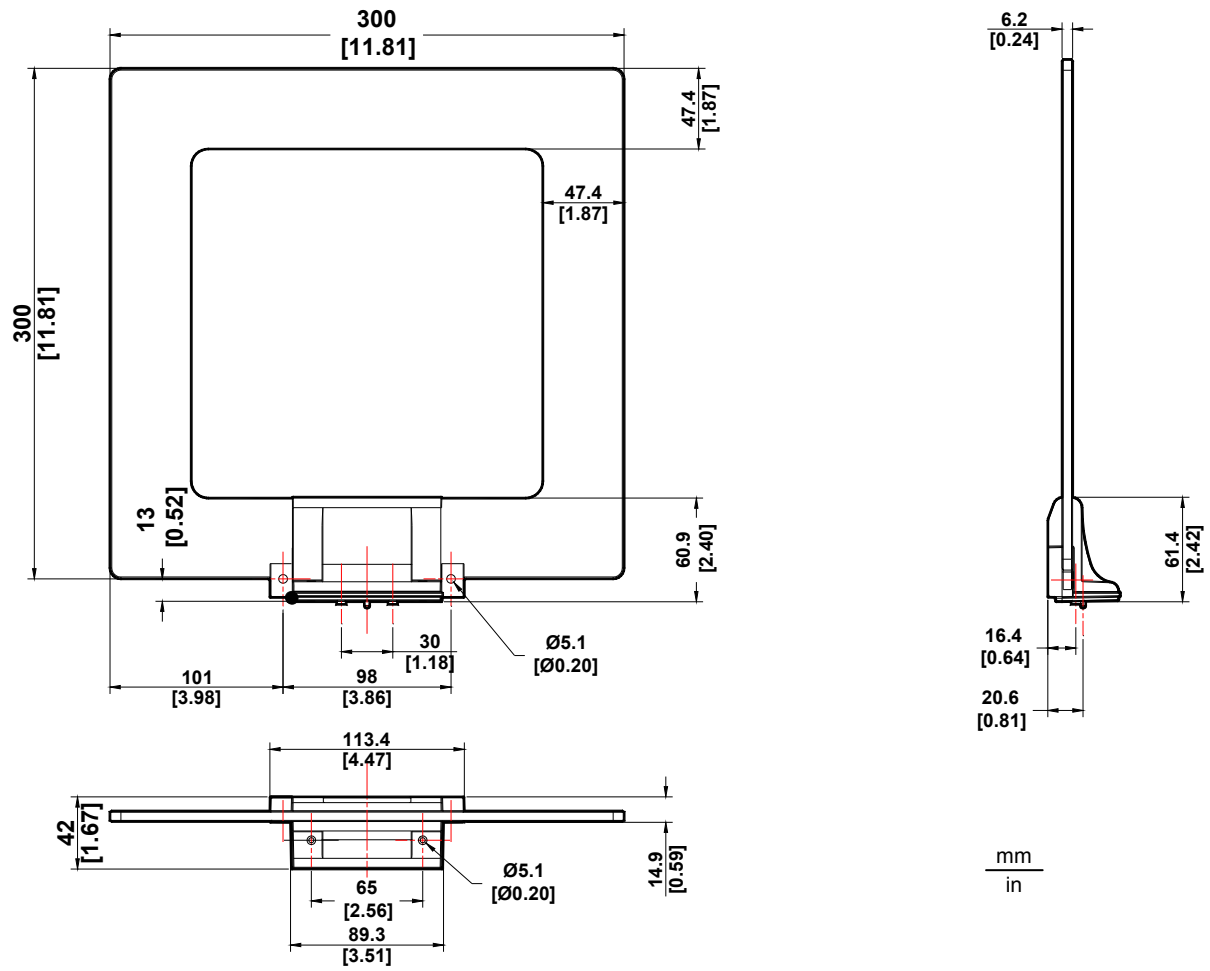


Figure 9 - HF-ANT-1010-01

HF-ANT-0750-01

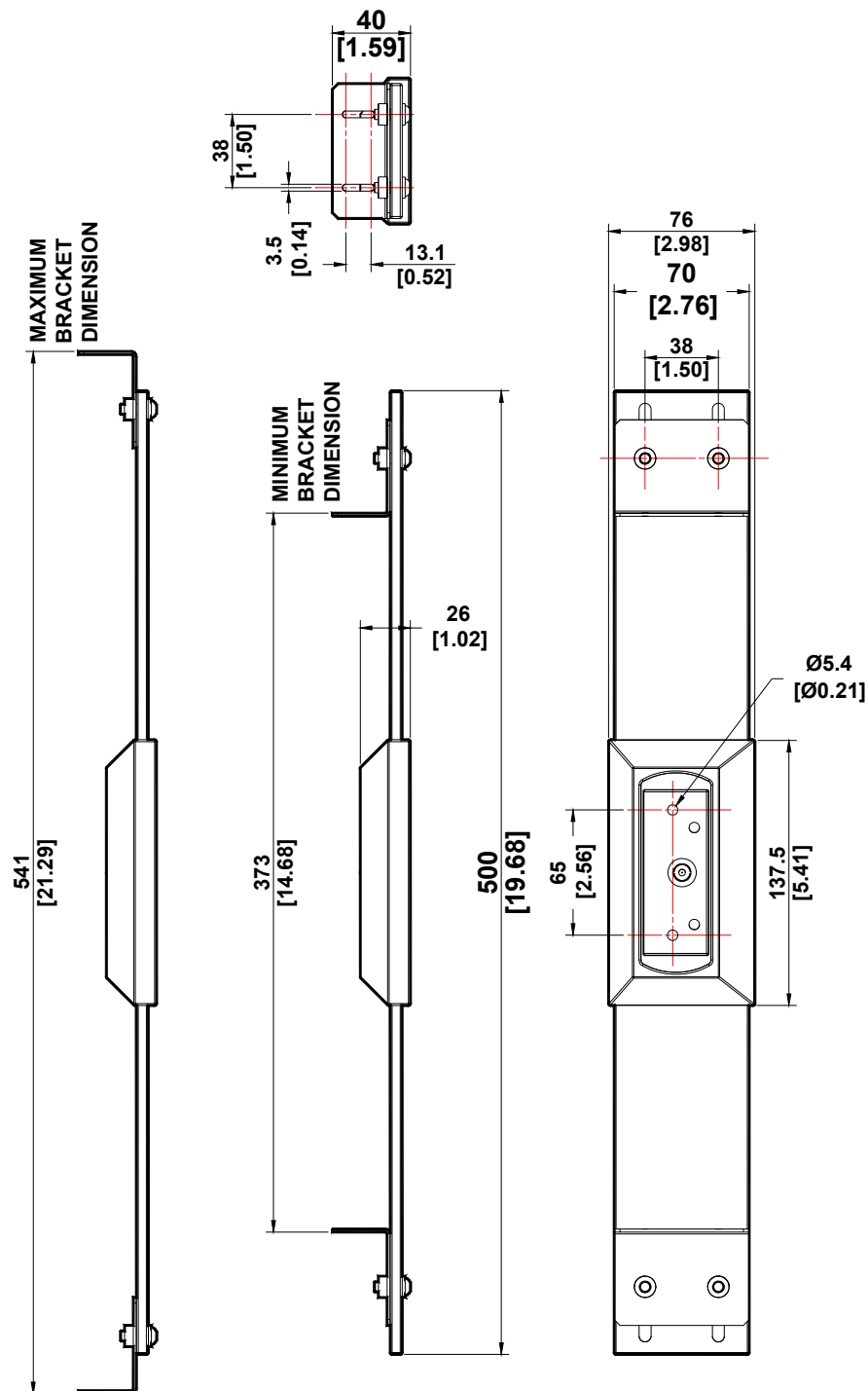
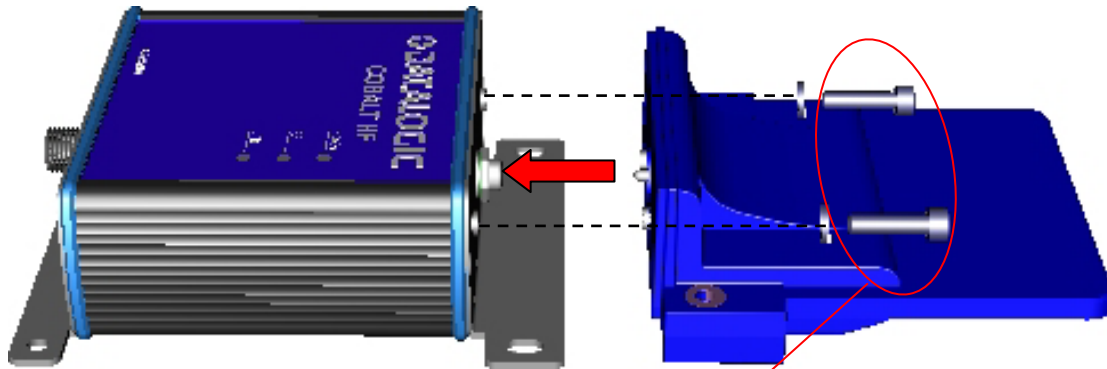


Figure 10 - HF-ANT-1010-01

2.2 HF-ANT-01 ANTENNA MOUNTING

2.2.1 Direct Antenna Mounting

Only -1010, -2020, and -3030 Antenna models



Antenna Mounting Screws (M5 x 20 mm) and Washers (M5) included in HF-CNTL package.

Figure 11 - Direct Antenna Mounting

The HF-ANT-01 RFID antennas (except HF-ANT-0750-01) are designed to be connected directly to the HF-CNTL-xxx-x2 Controllers using the hardware included in the Controller package.

1. Connect the Cobalt HF Antenna to the Cobalt HF Controller by inserting the RCA antenna plug into the RF port (RCA jack) on the controller, as shown above.
2. Secure the antenna to the controller using the two 20 mm M5 screws and washers provided with each Cobalt HF Series Controller. You can use the 4 mm hex key wrench supplied with each Cobalt Controller to tighten the screws to 1.7 Nm or 15 lbs per inch $\pm 10\%$.
3. Fasten the combined controller and antenna to your mounting fixture using M5 (or #10) diameter screws (not included). Pass the screws through the antenna's mounting holes and the controller bracket, and secure them with appropriate washers and nuts. Tighten screws to 1.7 Nm or 15 lbs per inch $\pm 10\%$.

To complete the installation, refer to the specific procedure for your controller under par. 2.6.

2.2.2 Remote Antenna Mounting

Using HF-ANT-CNTL-CBL-07-12 Extension Cable

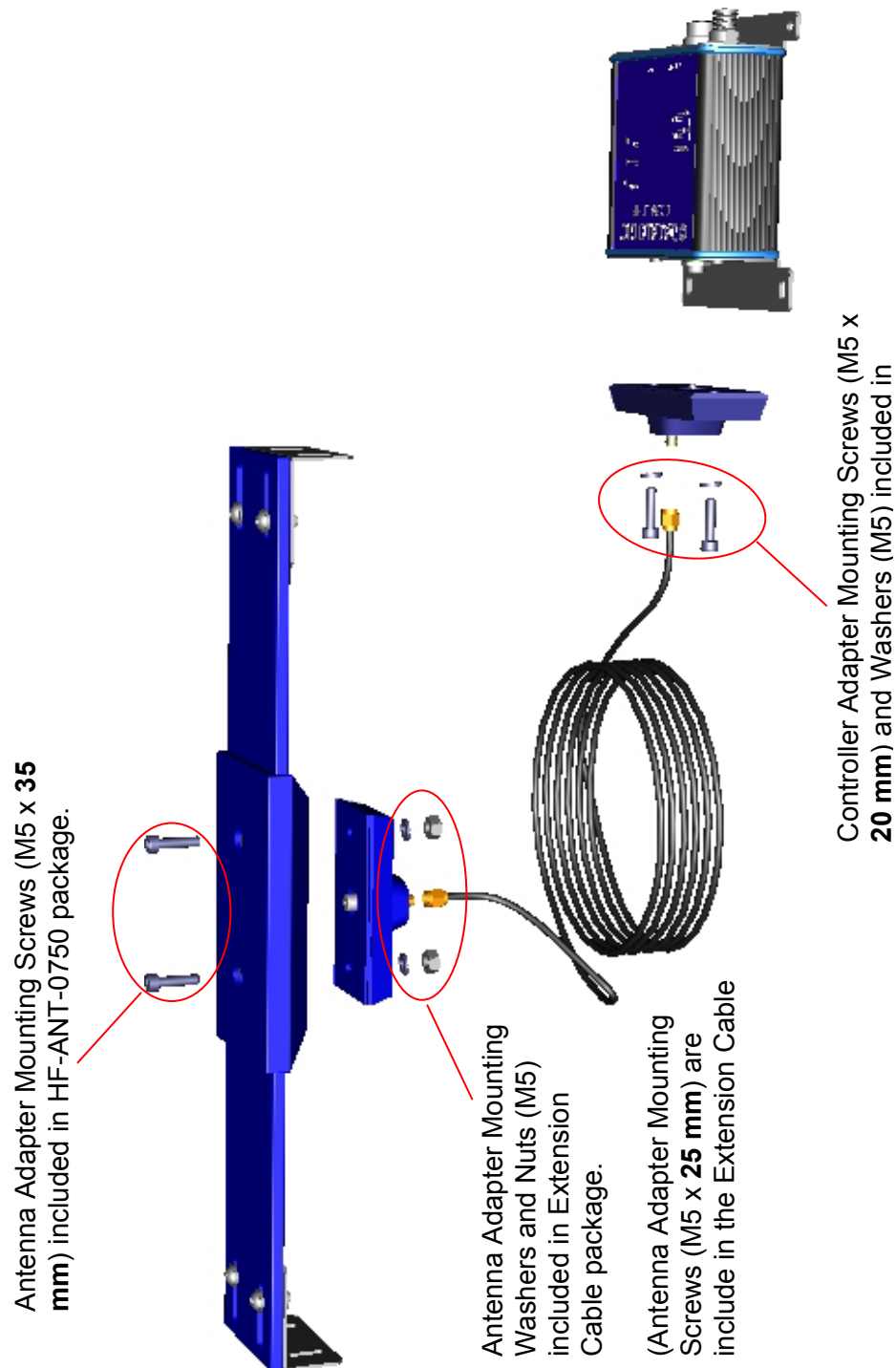


Figure 12 - Remote Antenna Mounting

All HF-ANT-01 RFID antennas can be connected remotely to the HF-CNTL-xxx-x2 Controllers through the HF-ANT-CNTL-CBL-07-12 Extension Cable.



NOTE

*You can use the 4 mm hex key wrench supplied with each Cobalt Controller to tighten all screws to **1.7 Nm or 15 lbs per inch ± 10%**.*

1. Mount the the **Controller Adapter** to the top of the controller using the two **20 mm** M5 screws and washers provided with each Cobalt HF Series Controller.
2. Mount the the **Antenna Adapter** to the bottom of the antenna as follows:
3. for Antenna models **-1010**, **-2020**, and **-3030**, use the two **25 mm** M5 screws, washers and nuts provided with the Cobalt HF-ANT-CNTL-CBL-07-12 Extension Cable kit.
4. for Antenna models **-0750**, use the two **35 mm** M5 screws provided with the Cobalt HF-ANT-0750-01 antenna. The M5 washers and nuts are in the Extension Cable kit.
5. Connect one end of the antenna extension cable to the RF port on the top of the Cobalt Controller-Side Adapter, attach the other end to the RF port on the bottom of the Cobalt Antenna-Side Adapter. Tighten both ends of the extension cable firmly by hand.
6. Fasten the controller and the antenna to your mounting fixtures using **M5 (or #10)** diameter screws (not included) and secure them with appropriate washers and nuts.

To complete the installation, refer to the specific procedure for your controller under par. 2.6.

2.2.3 Minimum Mounting Distance Between Adjacent Antennas

ANT	-1010	-2020	-3030	-0750
-1010	60 cm	75 cm	90 cm	50 cm
-2020	75 cm	90 cm	1.2 m	65 cm
-3030	90 cm	1.2 m	2 m	90 cm
-0750	50 cm	65 cm	90 cm	50 cm

2.2.4 Antenna to Tag Range

RF read/write range can be adversely affected by many environmental factors, including electrical noise, metallic objects and liquids. The tag ranges below are provided for design purposes only. Testing should be performed in the actual environment for more precise range results.

Typical Antenna-to-Tag Ranges for some of Datalogic Tags

Tag range values are listed in **mm / inches**.

Datalogic Tag Model	Cobalt HF-Series RFID Antenna [HF-ANT]				Testing Environment
	-1010-01	-2020-01	-3030-01	-0750-01	
LRP125(HT)S	152 / 6.0	216 / 8.5	228 / 9.0	57 / 2.25	Free Air
LRP250(HT)S	267 / 10.5	381 / 15.0	406 / 16.0	120 / 4.8	Free Air
LRP525HTS	254 / 10.0	381 / 15.0	432 / 17.0	127 / 5.0	Attached to Metal with spacers
LRP-P3858S	216 / 8.5	292 / 11.5	343 / 13.5	82 / 3.25	Free Air
HMS125(HT)	64 / 2.5	64 / 2.5	Not Advised	Not Advised	Free Air
HMS150(HT)	115 / 4.5	155 / 6.1	162 / 6.4	44 / 1.8	Free Air
LRP-P1212I	85 / 3.4	95 / 3.7	Not Advised	Not Advised	Free Air



NOTE

For further information regarding the Antenna-to-Tag Ranges, please refer to the specific Tag's Datasheet.

2.3 ELECTRICAL CONNECTORS

2.3.1 RS232

The RS232 Connector (M12 8-pin, Male) is used for a point-to-point serial connection between a host computer and the HF-Series RFID controller.

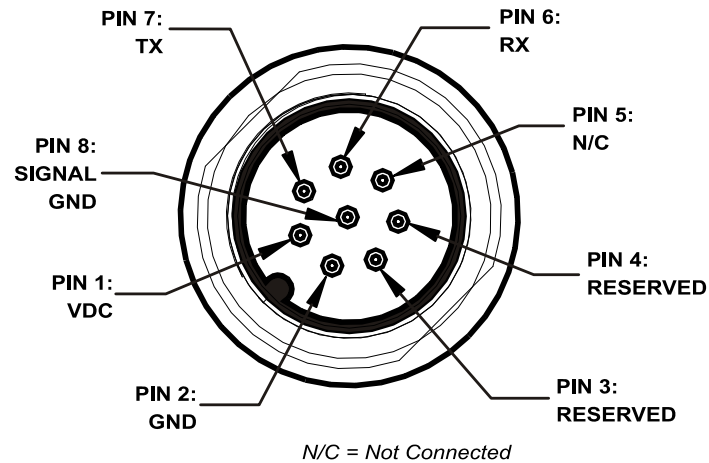


Figure 13 - RS232 Interface M12 8-pin Male Connector

Pin	Name	Function
1	Vdc	Input Power
2	GND	Power Ground
3	-	Reserved
4	-	Reserved
5	nc	
6	RX	RS232 Receive Data
7	TX	RS232 Transmit Data
8	SGND	Signal Ground

2.3.2 RS485

The Subnet16™ RS485 Connector (M12 5-pin, Male) is used for connecting the HF-Series RFID controllers to a Subnet16™ network.

These models are powered from the Subnet16™ network power.

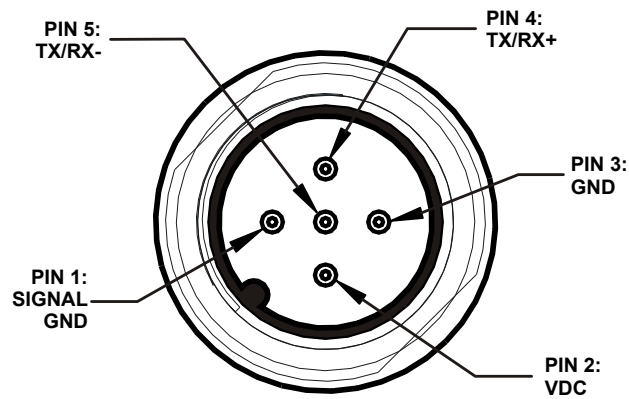


Figure 14 - RS485 Subnet16™ Interface M12 5-pin Male Connector

Pin	Name	Function
1	SGND	Signal Ground
2	Vdc	Subnet16™ Bus Power
3	GND	Subnet16™ Bus Ground
4	TX/RX+	Receive/Transmit Data positive
5	TX/RX-	Receive/Transmit Data negative

2.3.3 Industrial Ethernet IP

The Ethernet Connector (M12 4-pin D-coded, Female) is used for connecting the controller to an Ethernet network.

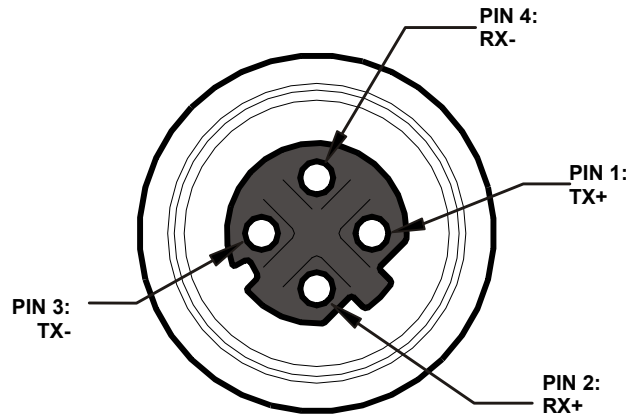
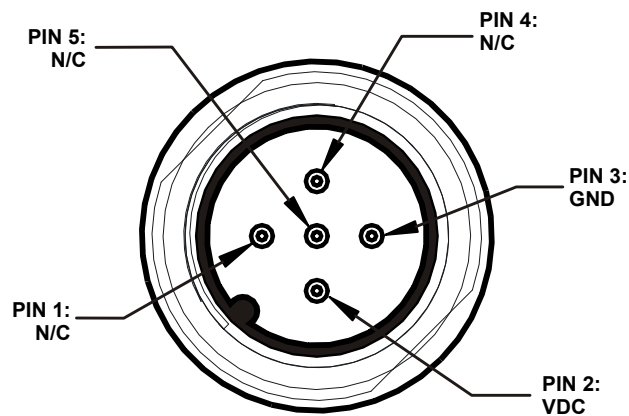


Figure 15 - M12 4-pin D-Coded Female Connector (for Ethernet)

Pin	Name	Function
1	TX+	Transmit Data positive
2	RX+	Receive Data positive
3	TX-	Transmit Data negative
4	RX-	Receive Data negative

The Industrial Ethernet models are powered through their VDC power connector (M12 5-pin, Male).



N/C = Not Connected

Figure 16 - M12 5-pin Male Connector (for Power Supply)

Pin	Name	Function
1	nc	
2	VDC	Input Power
3	GND	Power Ground
4	nc	
5	nc	

2.3.4 DeviceNet

The DeviceNet Connector (M12 5-pin, Male) is used for connecting the controller to a DeviceNet network.

These models are powered from the DeviceNet network power supply

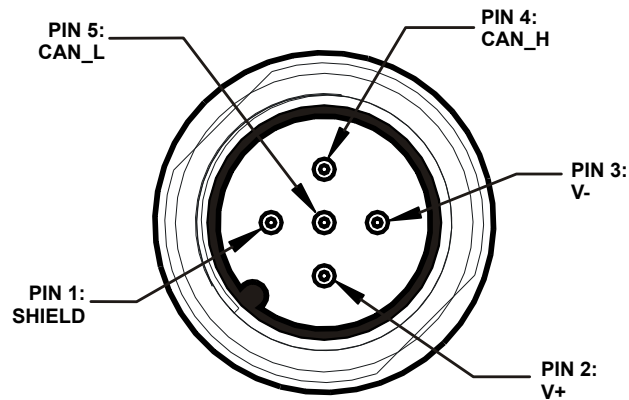


Figure 17 - M12 5-pin Male Connector (DeviceNet and Power Supply)

Pin	Name	Function
1	Shield	DeviceNet Bus Shield
2	V+	DeviceNet Bus Power
3	V-	DeviceNet Bus Ground
4	Can_H	Data positive
5	Can_L	Data negative

The RS232 Connector (M12 8-pin, Male) on the DeviceNet models is used for connecting the controller to a portable PC for configuration.

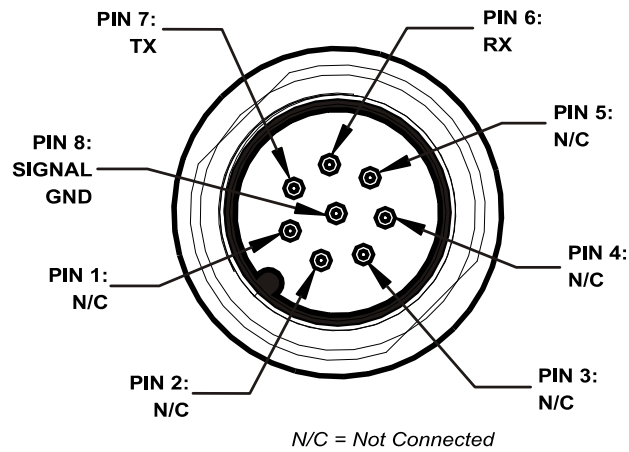


Figure 18 - M12 8-pin Male Connector (RS232)

Pin	Name	Function
1	nc	
2	nc	
3	nc	
4	nc	
5	nc	
6	RX	Receive Data
7	TX	Transmit Data
8	SGND	Signal Ground

2.3.5 Profibus

The Profibus IN Connector (M12 5-pin B-coded, Male) is used for connecting the controller to a Profibus network.

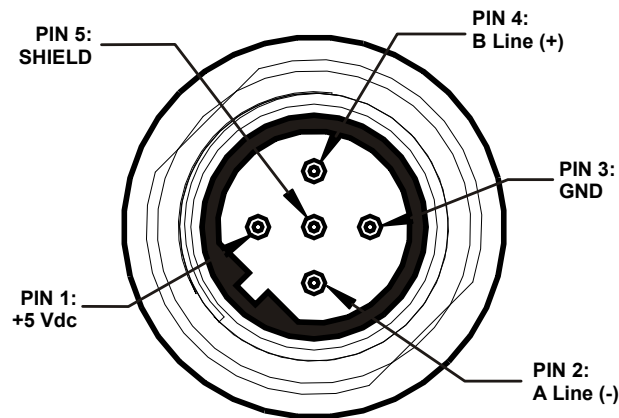


Figure 19 - M12 5-pin B-Coded Male Connector (Profibus-IN)

Pin	Name	Function
1	+5 Vdc	Bus Power for termination
2	A Line (-)	Data negative
3	GND	Bus Ground for termination
4	B Line (+)	Data positive
5	Shield	Profibus Shield

The Profibus OUT Connector (M12 5-pin B-coded, Female) is used for connecting the controller to a Profibus network.

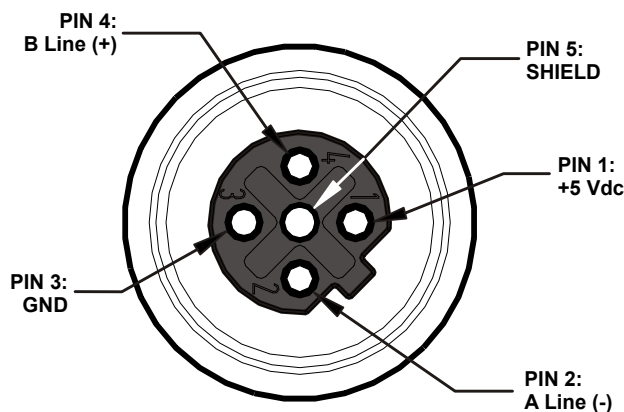


Figure 20 - M12 5-pin B-Coded Female Connector (Profibus-OUT)

Pin	Name	Function
1	+5 Vdc	Bus Power for termination
2	A Line (-)	Data negative
3	GND	Bus Ground for termination
4	B Line (+)	Data positive
5	Shield	Profibus Shield

The Profibus models are ONLY powered through their VDC power connector (M12 5-pin, Male).

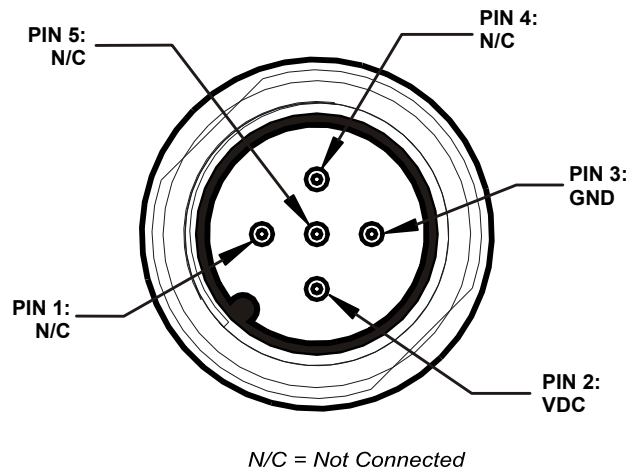


Figure 21 - M12 5-pin Male Connector (Power Supply)

Pin	Name	Function
1	Nc	
2	Vdc	Input Power
3	GND	Power Ground
4	Nc	
5	Nc	

The RS232 Connector (M12 8-pin, Male) on the Profibus models is used for connecting the controller to a portable PC for configuration.

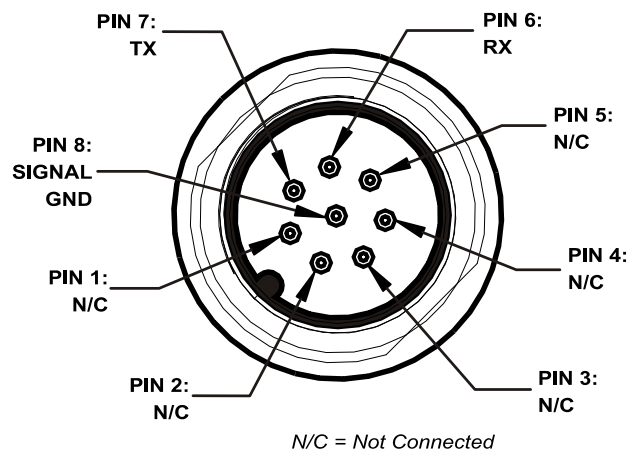


Figure 22 - M12 8-pin Male Connector (RS232)

Pin	Name	Function
1	nc	
2	nc	
3	nc	
4	nc	
5	nc	
6	RX	Receive Data
7	TX	Transmit Data
8	SGND	Signal Ground

2.3.6 Profinet

The PNT1 and PNT2 Profinet Connectors (M12 4-pin D-coded, Female) are used for connecting the controller to a Profinet network.

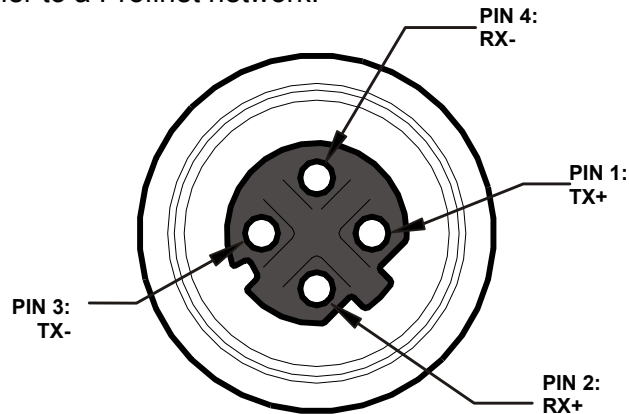
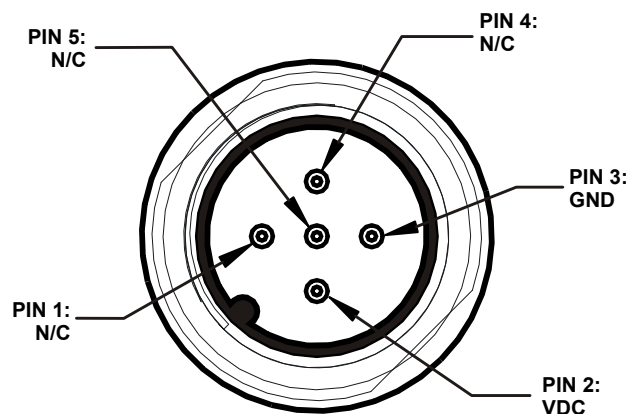


Figure 23 - M12 4-pin D-Coded Female Connector (for Profinet)

Pin	Name	Function
1	TX+	Transmit Data positive
2	RX+	Receive Data positive
3	TX-	Transmit Data negative
4	RX-	Receive Data negative

The Profinet models are powered through their VDC power connector (M12 5-pin, Male).



N/C = Not Connected

Figure 24 - M12 5-pin Male Connector (for Power Supply)

Pin	Name	Function
1	nc	
2	VDC	Input Power
3	GND	Power Ground
4	nc	
5	nc	

The RS232 Connector (M12 8-pin, Male) on the Profinet models is used for connecting the controller to a portable PC for configuration.

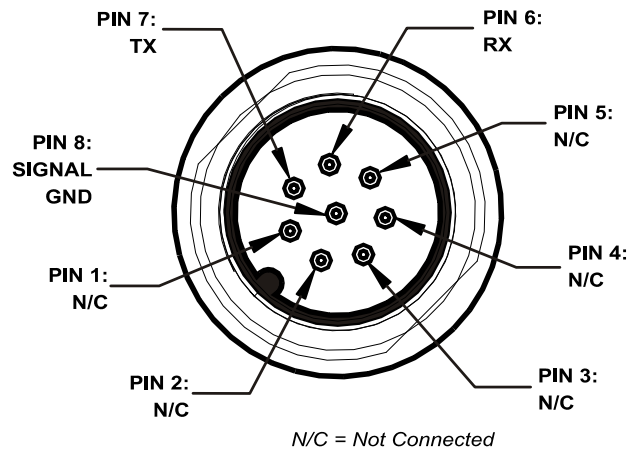


Figure 25 - M12 8-pin Male Connector (RS232)

Pin	Name	Function
1	nc	
2	nc	
3	nc	
4	nc	
5	nc	
6	RX	Receive Data
7	TX	Transmit Data
8	SGND	Signal Ground

2.3.7 Digital I/O (-12 models)

The Digital I/O Connector (M12 8-pin Female Connector) is used for connecting the controller to optional external digital input/output devices. See par. 2.7 for further details.

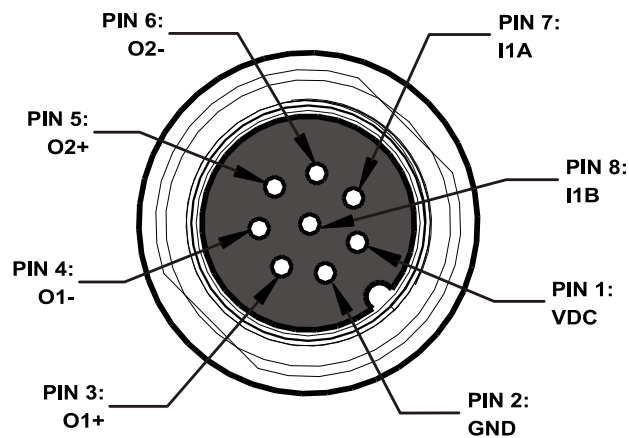


Figure 26 - M12 8-pin Female Connector (Digital I/O)

Pin	Name	Function
1	Vdc	Power <u>from</u> the controller to the I/O device
2	GND	Power Ground
3	O1+	Output 1 positive
4	O1-c	Output 1 negative
5	O2+	Output 2 positive
6	O2-	Output 2 negative
7	I1A	Input 1A (optocoupled polarity insensitive)
8	I1B	Input 1B (optocoupled polarity insensitive)



CAUTION

The Vdc and Ground pins on this connector must not be used to power the controller. They can only be used to optionally supply the I/O device within the limits specified in par. 2.7 and in the Technical Features.

2.4 POWER & WIRING

The information presented below is provided to assist the installer in determining the amount of power that will be required by the HF-Controller depending on the application.

2.4.1 Power Requirements

The HF-Series controller requires an electrical supply voltage of 12 to 30 Vdc. Use a regulated power supply that is capable of delivering the requirements listed in the Technical Features.

For point-to-point or individually powered slave nodes, the calculation is straight forward. The calculation becomes more complex for network power sources.

The following information is provided to assist you in determining the power requirements of an RFID network application, in particular a Subnet16™ network.



NOTE

Power is applied directly to the Subnet16™ Network trunk and distributed through drop cables to the Gateway and RFID controllers. By positioning the power supply near the middle of the network, you can limit voltage drop at the ends, (see par. 2.6.2 for network layout diagrams).

2.4.2 Total System Current Consumption



NOTE

The current consumption values of each product are given in the Technical Features paragraph of the relative Installation manual and refer to the min and max input voltage range. These values already include an adequate safety margin. The consumption values given in the following examples have been interpolated for an input voltage of 24 Vdc.

Max Gateway Current: 200 mA @ 12 Vdc (133 mA @ 24 Vdc).

Max Controller Current: 366 mA @ 24 Vdc for Cobalt HF-Series

Calculating Total System Current Consumption:

Total System Current Consumption = [Max Gateway Current + (Max Controller Current x Number of Controllers)]

Example

A Subnet16™ network powered at 24 Vdc is composed of a GWY-01-xxx-01 connecting eight HF-CNTL-485 RFID Controllers.

Total System Current Consumption = [0.133 A + (0.366 A X 8)] = 3.061 A

2.4.3 Cable Voltage Drop

In addition, each RFID controller on the Subnet will experience a certain amount of voltage drop depending on the length of the cable.

Cable Resistance per Meter

- ThinNet = **0.058 ohms** per meter per wire
- ThickNet = **0.0105 ohms** per meter per wire

Calculating Voltage Drop

$$\text{Voltage Drop} = (\text{Max Controller Current} \times \text{Number of Controllers}) \times (\text{Cable Resistance per Meter per Wire}^1 \times \text{Cable length in Meters})$$

Example

A Subnet16™ network is composed of a GWY-01-xxx-01 connecting eight HF-CNTL-485 RFID Controllers (366 mA each @ 24 Vdc). A total of 20 meters of ThinNet cables are used to connect the devices, which have Cable Resistance = 0.058 Ohms per meter per wire. The network power is 24 Vdc.

The voltage drop calculation must be conducted on the RFID controller that is farthest from the Power Supply, as it will experience the greatest voltage drop.



NOTE

It is always recommended to power the network from the middle (T-configuration), to reduce total voltage drop at the ends. In the example below this allows the fourth controller and not the eighth to be the furthest from the power supply.

$$\text{Voltage Drop} = [0.133 \text{ A GWY} + (0.366 \text{ A} \times 8 \text{ controllers})] \times [(0.058 \times 2) \times 20 \text{ meters}] = 7.10 \text{ Vdc total voltage drop for 8 controllers}$$

$$24 \text{ Vdc} - 7.10/2 = 20.45 \text{ Vdc at controller number 4 of each branch}$$

2.4.4 Current Rating for Cables

The maximum current rating for the Subnet16™ network using Datalogic Automation's cables and accessories (CBL-xxxx), is **4.0 A**.

¹ The resistance calculation must include both wires (Vdc and GND).

2.5 INSTALLATION GUIDELINES

2.5.1 Hardware Requirements

The following is a list of minimum components required to create an RFID reading system. Other components may be required depending on the controller model, see the specific installation procedure for your model.

- Host computer with specific interface (Serial, Subnet16™ or Fieldbus); Programmable Logic Controller (PLC) or PC
- RFID controller(s) (*Cobalt C-Series, HF-Series or UHF-Series Controllers*)
- Adequate length cabling, connectors and terminators
- Sufficient power capable of powering all the RFID components
- Datalogic Automation RFID series tags: HMS, LRP, T/Gamma, I, or UHF-G2-525

2.5.2 Installation Precautions

- RF performance and read/write range can be negatively impacted by the proximity of metallic objects and liquids. Avoid mounting the Cobalt antenna within 15 cm (6 inches) of any metallic object or wet surface.
- Do not route cables near other unshielded cables or near wiring carrying high voltage or high current. Cross cables at perpendicular intersections and avoid routing cables near motors and solenoids.
- Avoid mounting the controller near sources of EMI (electro-magnetic interference) or near devices that generate high ESD (electro-static discharge) levels. Always use adequate ESD prevention measures to dissipate potentially high voltages.
- If electrical interference is encountered (as indicated by a significant reduction in read/write performance), relocate the controller to an area free from potential sources of interference.

2.6 TYPICAL LAYOUTS AND INSTALLATION PROCEDURES

2.6.1 Installing the HF-Series RS232

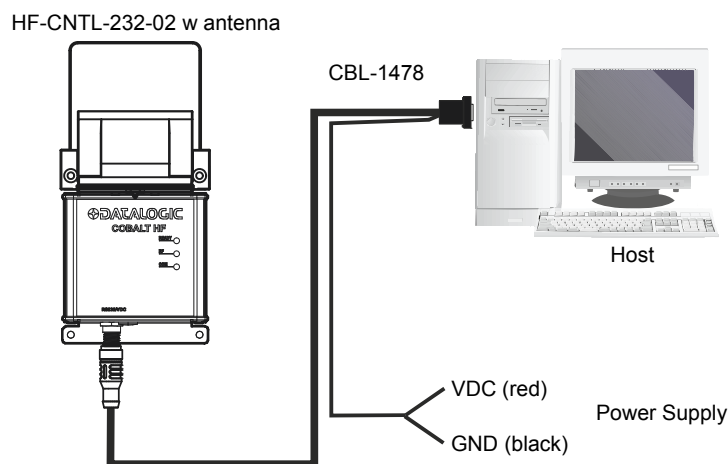


Figure 27 - RS232 Typical Layouts

The HF-CNTL-232-x2 RFID Controller is designed for point-to-point RFID applications, where the distance from host to controller is less than 15 meters (50 feet). The controller connects directly to a serial communications port on a host computer via an RS232-compatible serial interface cable.

1. Select a suitable location for the Cobalt HF Controller/Antenna.
2. Mount the Cobalt HF Antenna to the Cobalt HF Controller, either directly or remotely, as described in par. 2.2.
3. Mount the controller and antenna to your mounting fixture using **M5 (or #10)** diameter screws (*not included*) and secure them with appropriate washers and nuts. Tighten screws to **1.7 Nm or 15 lbs per inch $\pm$ 10%**.
4. Connect the CBL-1478 M12 8-pin female connector to the M12 8-pin male interface connector on the Cobalt HF-CNTL-232-x2. Connect the CBL-1478 9-pin female D-sub connector to an RS232 COM port on the host computer. Tighten the cable's two locking thumbscrews.
5. Connect the power supply to the VDC (red) and GND (black) wires on the CBL-1478 cable.
6. Apply power to the controller after all cable connections have been made. The LEDs on the unit will flash. The READY LED is ON after the power up sequence has completed.
7. On the host computer, set the COM port parameters to: 9600 baud, 8 data bits, 1 stop bit, no parity and no handshaking.

To verify operations, download the Cobalt Dashboard™ Utility from www.automation.datalogic.com. The Cobalt Dashboard™ Utility allows users to configure and control their HF-CNTL-232-x2 controllers and send RFID commands for testing purposes. See the Cobalt Dashboard™ Reference Manual for details.

2.6.2 Installing the HF-Series RS485

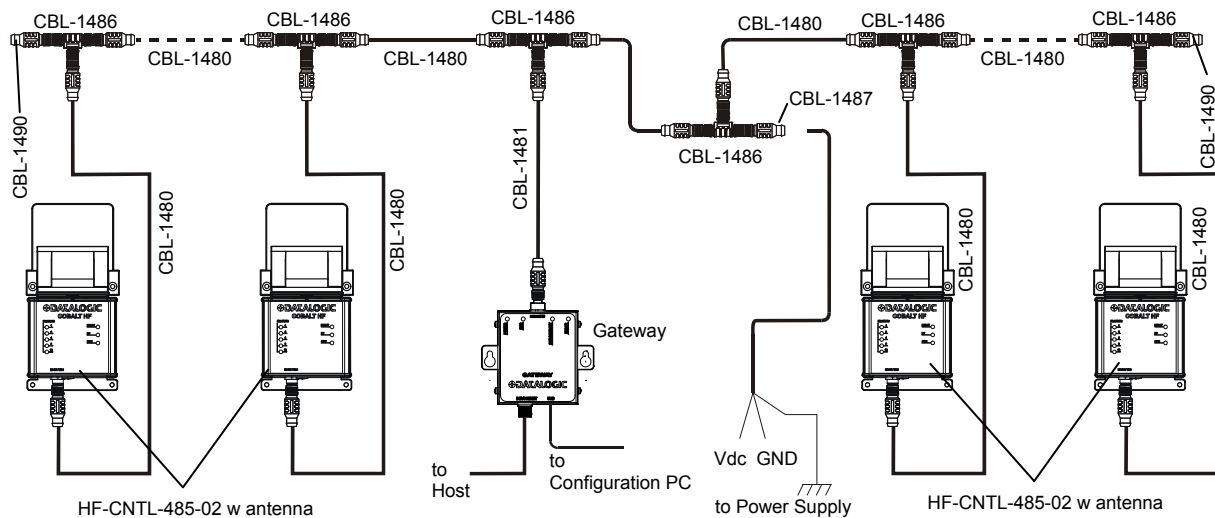


Figure 28 - RS485 Typical Layouts

See Gateway or Hub Reference Manual for further connection details.

The HF-CNTL-485-x2 RFID Controller is designed for Subnet16™ RFID applications, where the controller is connected in an RS485 network via Subnet16™-compatible cables to the host through a Gateway or Hub.

1. Select a suitable location for the Cobalt HF Controller/Antenna.
2. Mount the Cobalt HF Antenna to the Cobalt HF Controller, either directly or remotely, as described in par. 2.2.
3. Mount the controller and antenna to your mounting fixture using **M5 (or #10)** diameter screws (*not included*) and secure them with appropriate washers and nuts. Tighten screws to **1.7 Nm or 15 lbs per inch ± 10%**.
4. Attach a Subnet16™ compatible cable (i.e. CBL-1480-xx) to the M12 5-pin male Subnet16™ connector on the controller. Connect the other end of this cable to your Subnet16™ network.
5. To complete the Subnet16™ network installation, including power supply wiring, trunk wiring, network termination, Gateway/Hub wiring, and for a complete list of compatible accessory cables and Subnet16™ network layout examples, see the Subnet16™ Gateway or Subnet16™ Hub Reference Manuals.

After installation, the Subnet16™ network can be configured through the Subnet16™ Gateway/Hub using the Cobalt Dashboard™ Utility. See the Cobalt Dashboard™ Reference Manual for details.

2.6.3 Installing the HF-Series Industrial Ethernet (IND)

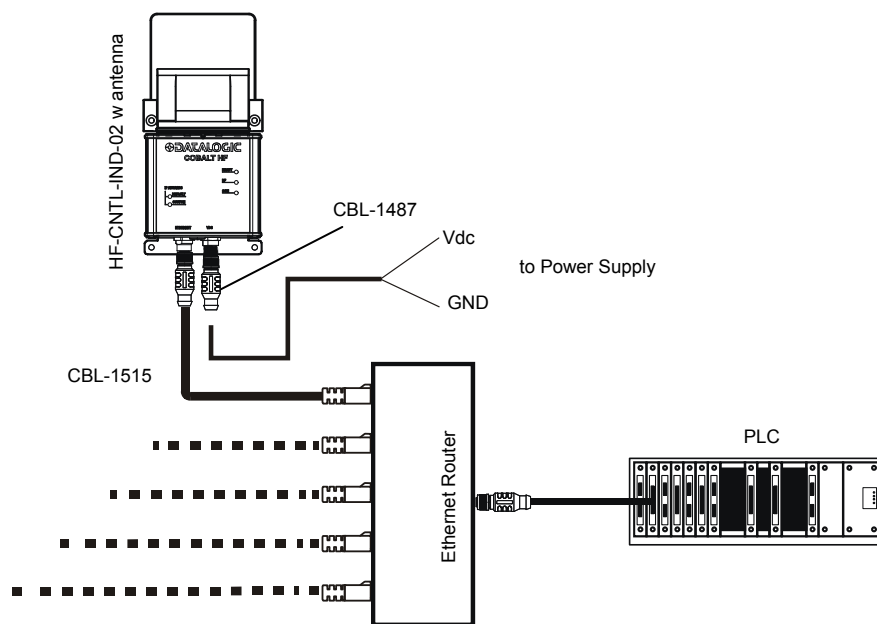


Figure 29 - IND Typical Layouts

The HF-CNTL-IND-x2 RFID Controller is designed for Industrial Ethernet IP RFID applications, where the controller is connected in an Ethernet IP TCP/IP network via compatible cables through a hub or directly to an Ethernet IP host.

1. Select a suitable location for the Cobalt HF Controller/Antenna.
2. Mount the Cobalt HF Antenna to the Cobalt HF Controller, either directly or remotely, as described in par. 2.2.
3. Mount the controller and antenna to your mounting fixture using **M5 (or #10)** diameter screws (*not included*) and secure them with appropriate washers and nuts. Tighten screws to **1.7 Nm or 15 lbs per inch $\pm$ 10%**.
4. Connect the CBL-1515 M12 4-pin male connector to the M12 4-pin female interface connector on the Cobalt HF-CNTL-IND-x2. Connect the CBL-1515 RJ45 male connector to the LAN hub/switch. If connecting directly to the host computer you will need to use an additional crossover cable.
5. Build a power supply cable using the CBL-1487 M12 5-pin female connector. Use minimum 24 AWG wires for connection to the power supply lines according to the Vdc connector pinout. Connect the CBL-1487 M12 5-pin female connector to the M12 5-pin male connector on the controller. Connect the other end of the cable (wires or user-supplied connectors) to the power supply.
6. Apply power to the controller after all cable connections have been made. The LEDs on the unit will flash. The READY LED is ON after the power up sequence has completed. Then one of the Ethernet IP Address LEDs will remain on, either Default or Custom.

To verify operations, download the Cobalt Dashboard™ Utility from www.automation.datalogic.com. The Cobalt Dashboard™ Utility allows users to configure and control their HF-CNTL-IND-x2 controllers and send RFID commands for testing purposes. See the Cobalt Dashboard™ Reference Manual for details.

2.6.4 Installing the HF-Series DeviceNet (DNT)

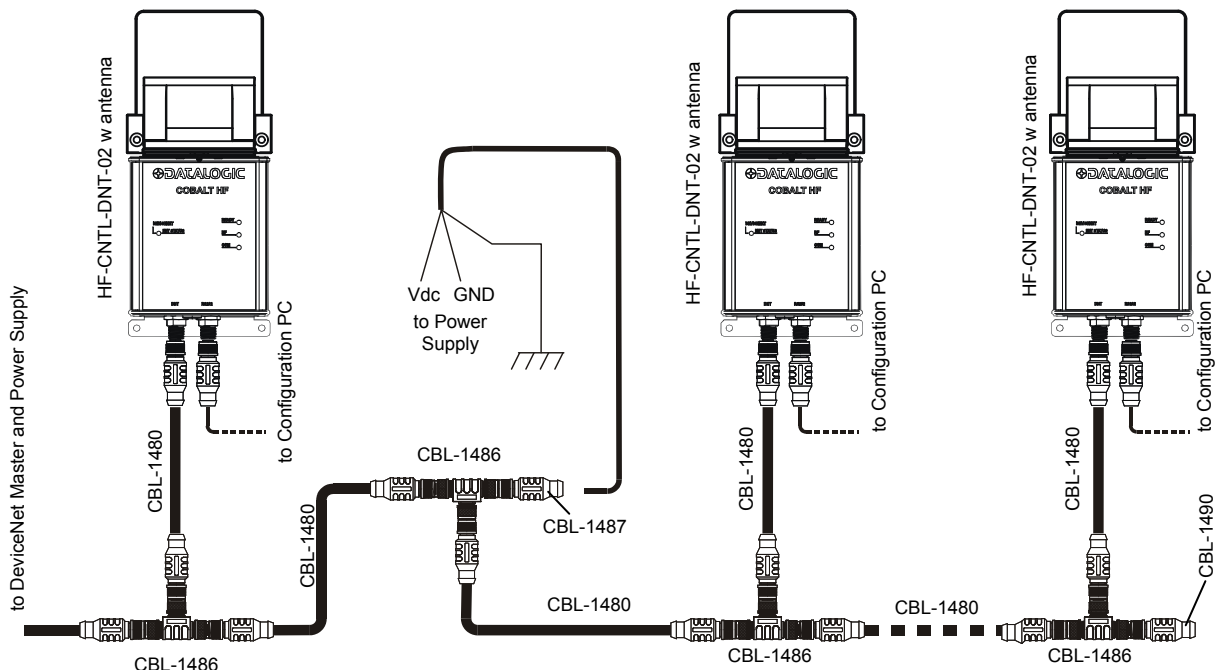


Figure 30 - DNT Typical Layouts

The HF-CNTL-DNT-02 RFID Controller is designed for DeviceNet RFID applications, where the controller is connected as a slave node in a DeviceNet network via compatible cables directly to a DeviceNet Master/Scanner (host). **The default Node ID is 63.**

1. Select a suitable location for the Cobalt HF Controller/Antenna.
2. Mount the Cobalt HF Antenna to the Cobalt HF Controller, either directly or remotely, as described in par. 2.2.
3. Mount the controller and antenna to your mounting fixture using **M5 (or #10)** diameter screws (*not included*) and secure them with appropriate washers and nuts. Tighten screws to **1.7 Nm or 15 lbs per inch $\pm$ 10%**.
4. Attach a DeviceNet-compatible cable to the 5-pin, male M12 interface connector on the Cobalt. Connect the other end of this cable to your DeviceNet network.
5. Turn your DeviceNet power supply ON. After a while the Devicenet LED will briefly flash alternatively Red and Green. The READY LED will be ON when the controller's startup procedure has completed.

To configure and control the HF-CNTL-DNT-02 controller and send RFID commands for testing purposes, download and install the Cobalt Dashboard™ Utility from www.automation.datalogic.com. The Dashboard utility uses the PC RS232 serial port to communicate to the controller's RS232 serial port. To enable communication:

1. To connect the controller's RS232 serial port to the PC you have two choices; the first one is the quickest: a) Connect the CBL-1478 M12 8-pin female connector to the M12 8-pin male interface connector on the Cobalt HF-CNTL-DNT-02. Connect the CBL-1478 9-pin female D-sub connector to an RS232 COM port on the host computer, or, b) Build your own communication cable using the CBL-1493 connector M12 8-pin female connector and follow the schematic shown in par. 2.3.4.
2. On the host computer, set COM port parameters to: 9600 baud, 8 data bits, 1 stop bit, no parity and no handshaking.
3. Run the Cobalt Dashboard™ Utility.

2.6.5 Installing the HF-Series Profibus (PBS)

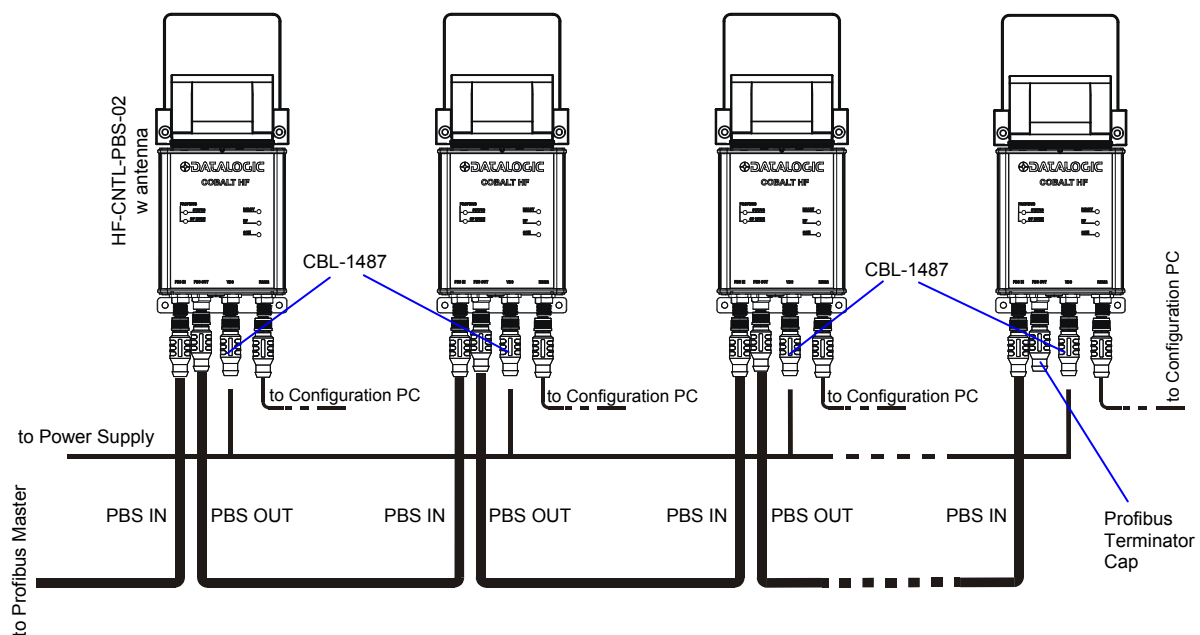


Figure 31 - PBS Typical Layouts

The HF-CNTL-PBS-02 RFID Controller is designed for Profibus RFID applications, where the controller is connected as a slave node in a Profibus (DP) network via compatible cables directly to a Profibus Master (host). **The default Node ID is 63.**

1. Select a suitable location for the Cobalt HF Controller/Antenna.
2. Mount the Cobalt HF Antenna to the Cobalt HF Controller, either directly or remotely, as described in par. 2.2.
3. Mount the controller and antenna to your mounting fixture using **M5 (or #10)** diameter screws (*not included*) and secure them with appropriate washers and nuts. Tighten screws to **1.7 Nm or 15 lbs per inch $\pm$ 10%**.
4. Attach Profibus-compatible data cables to the 5-pin B-Coded (reverse-keyed), male and female M12 interface connectors on the Cobalt. Connect the other end of the cables to your Profibus network.
5. Build a power supply cable using the CBL-1487 M12 5-pin female connector. Use minimum 24 AWG wires for connection to the power supply lines according to the Vdc connector pinout. Connect the CBL-1487 M12 5-pin female connector to the M12 5-pin male connector on the controller. Connect the other end of the cable (wires or user-supplied connectors) to the power supply.
6. Apply power to the controller after all cable connections have been made. The LEDs on the unit will flash. The READY LED is ON after the power up sequence has completed.

To configure and control the HF-CNTL-PBS-02 controller and send RFID commands for testing purposes, download and install the Cobalt Dashboard™ Utility from www.automation.datalogic.com. The Dashboard utility uses the PC RS232 serial port to communicate to the controller's RS232 serial port. To enable communication:

1. To connect the controller's RS232 serial port to the PC you have two choices; the first one is the quickest: a) Connect the CBL-1478 M12 8-pin female connector to the M12 8-pin male interface connector on the Cobalt HF-CNTL-PBS-02. Connect the CBL-1478 9-pin female D-sub connector to an RS232 COM port on the host computer, or, b) Build your own communication cable using the CBL-1493 connector M12 8-pin female connector and follow the schematic shown in par. 2.3.5.
2. On the host computer, set COM port parameters to: 9600 baud, 8 data bits, 1 stop bit, no parity and no handshaking.
3. Run the Cobalt Dashboard™ Utility.

2.6.6 Installing the HF-Series Profinet (PNT)

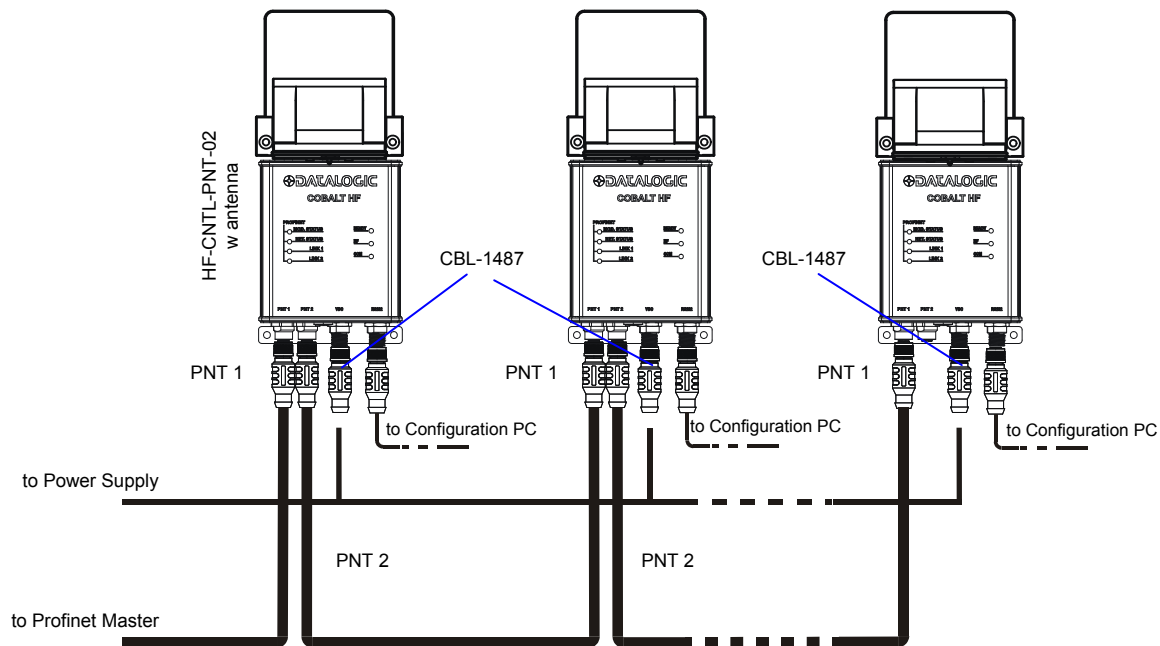


Figure 32 - PNT Typical Layouts

The HF-CNTL-PNT-02 RFID Controller is designed for Profinet RFID applications, where the controller is connected as a slave node in a Profinet IO network via compatible cables directly to a Profinet Master (host). **The default IP Address is 192.168.253.110.**

1. Select a suitable location for the Cobalt HF Controller/Antenna.
2. Mount the Cobalt HF Antenna to the Cobalt HF Controller, either directly or remotely, as described in par. 2.2.
3. Mount the controller and antenna to your mounting fixture using **M5 (or #10)** diameter screws (*not included*) and secure them with appropriate washers and nuts. Tighten screws to **1.7 Nm or 15 lbs per inch $\pm$ 10%**.
4. Attach Profinet-compatible data cables to the 4-pin D-Coded, female M12 interface connectors on the Cobalt. Connect the other end of the cables to your Profinet network.
5. Build a power supply cable using the CBL-1487 M12 5-pin female connector. Use 18 AWG (max) to 24 AWG (min) wires for connection to the power supply lines according to the Vdc connector pinout. Connect the CBL-1487 M12 5-pin female connector to the M12 5-pin male connector on the controller. Connect the other end of the cable (wires or user-supplied connectors) to the power supply.
6. Apply power to the controller after all cable connections have been made. The LEDs on the unit will flash. The READY LED is ON after the power up sequence has completed.

To configure and control the HF-CNTL-PNT-02 controller and send RFID commands for testing purposes, download and install the Cobalt Dashboard™ Utility from www.automation.datalogic.com. The Dashboard utility uses the PC RS232 serial port to communicate to the controller's RS232 serial port. To enable communication:

1. To connect the controller's RS232 serial port to the PC you have two choices; the first one is the quickest: a) Connect the CBL-1478 M12 8-pin female connector to the M12 8-pin male interface connector on the Cobalt HF-CNTL-PNT-02. Connect the CBL-1478 9-pin female D-sub connector to an RS232 COM port on the host computer, or, b) Build your own communication cable using the CBL-1493 connector M12 8-pin female connector and follow the schematic shown in par. 2.3.6.
2. On the host computer, set COM port parameters to: 9600 baud, 8 data bits, 1 stop bit, no parity and no handshaking.
3. Run the Cobalt Dashboard™ Utility.

2.7 DIGITAL I/O (-12 MODELS)

2.7.1 Input

There is one optocoupled polarity insensitive input available on the Controllers with the I/O option. See par. 2.3.7 for pinout.

“Polarity Insensitive” means that, in the applications examples shown below, the user can exchange I1A with I1B without affecting the system behaviour.

The user can handle the input through specific commands (see par. 2.7.3 for the specific Cobalt Command Protocol Reference Manual according to your controller model).

The electrical features of the input are:

- Maximum voltage: 30 Vdc

- Minimum voltage: 6 Vdc

- Maximum current: 28 mA

The input is optocoupled and can be driven by both an NPN and PNP type command.

Input Connections Using Controller Power

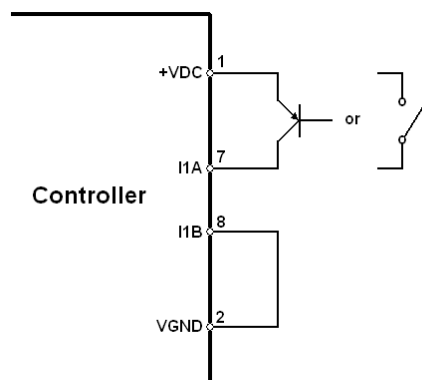


Figure 33 - PNP External Trigger Using Controller Power

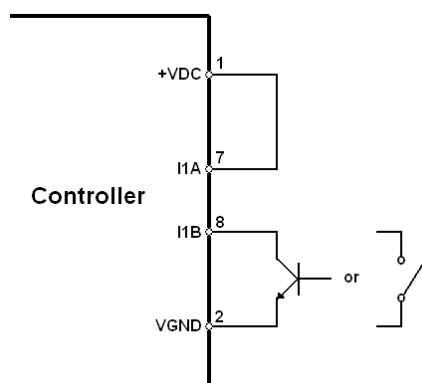


Figure 34 - NPN External Trigger Using Controller Power

Input Connections Using External Power

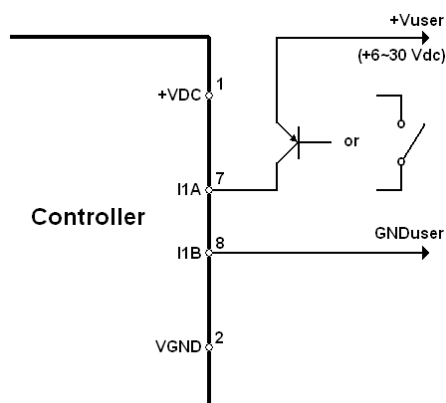


Figure 35 - PNP External Trigger Using External Power

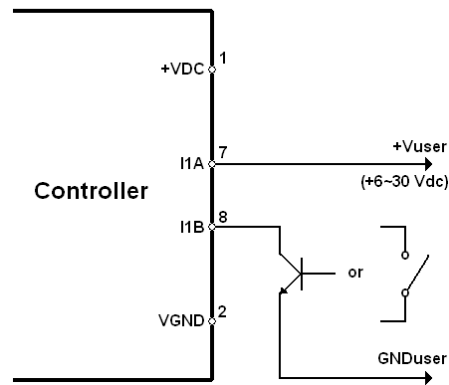


Figure 36 - NPN External Trigger Using External Power

2.7.2 Outputs

Two general purpose optocoupled outputs are available on the Controllers with the I/O option. See par. 2.3.7 for pinout.

The user can activate/deactivate the two outputs through specific commands (see par. 2.7.3 for the specific Cobalt Command Protocol Reference Manual according to your controller model).

When connected to an external circuit, the current must enter in O1+/O2+ and exit from O1-/O2-.

The electrical features of the outputs are:

Voltage Range: 6 ~ 30 Vdc

Maximum Current:

- If externally powered (by the user): 500 mA
- If powered by the controller (pins 1 and 2 of the I/O connector): max. 300 mA (*)

(*) This is the maximum value of current computed as the sum of both the Outputs! In fact the output current supplied by the controller is limited. In other words if only one output is active the maximum current value is 300 mA, but if both the outputs are active then each Output current must decrease (for example max. 150 mA for each Output).

Notes

- It should be noted that if the power supply for the I/O is supplied by the Controller (pins 1 and 2), the opto-isolation feature for the Input and Output sections will be lost, because the ground reference of the I/O and the Controller power supply is the same.
- A device that operates at 200 mA may damage the Digital Output due to inrush current if a current limiting device is not used and the current exceeds 500 mA (e.g. an incandescent light).
- The inductive "kick" that occurs when a relay is released (back EMF from a collapsing magnetic field) can impose a voltage higher than 30 Vdc that may damage the output transistor. To avoid this potential issue, employ a diode (D1) to clamp the back EMF. D1 should be a 1N4001 or equivalent.

The following connection diagrams show examples involving only Output1; the same principles are valid and applicable also to Output2.

Output Connections Using Controller Power

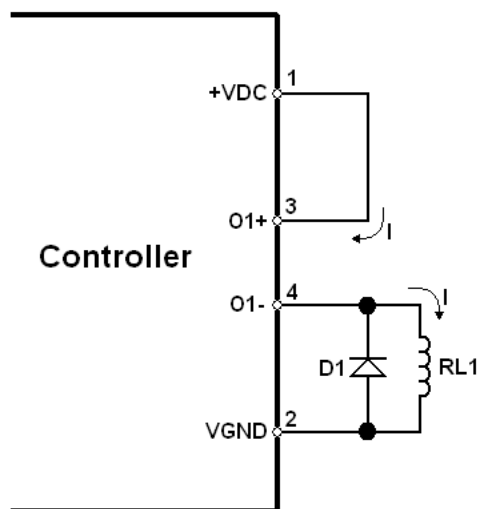


Figure 37 - Open Emitter (Sourcing) Output Using Controller Power

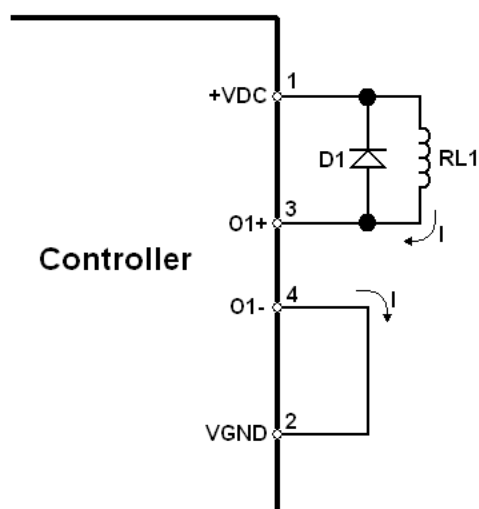


Figure 38 - Open Collector (Sinking) Output Using Controller Power

Output Connections Using External Power

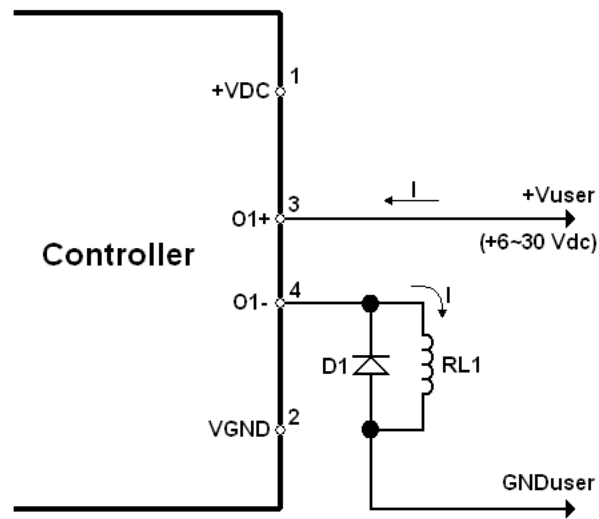


Figure 39 - Open Emitter (Sourcing) Output Using External Power

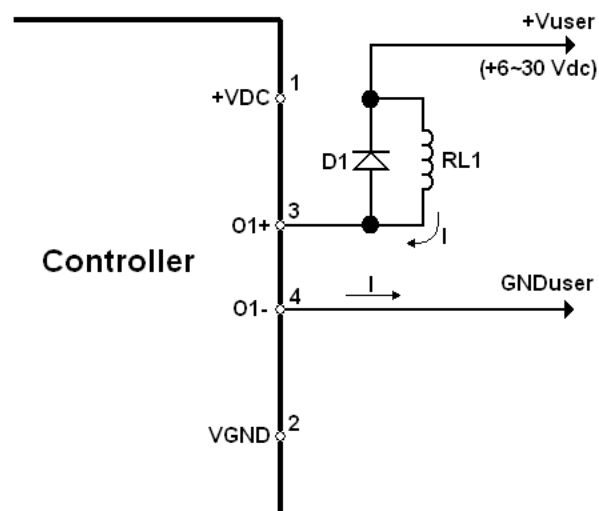


Figure 40 - Open Collector (Sinking) Output Using External Power

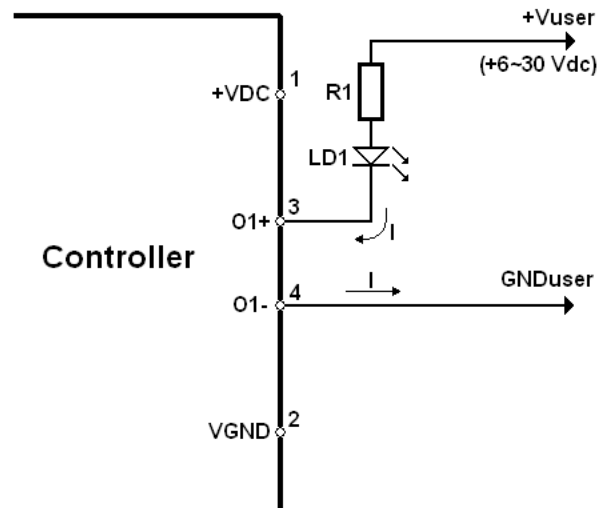


Figure 41 - Open Collector (Sinking) Output for a LED Using External Power

Note

- The resistor R1 in series with the LED LD1 sets the forward current; a value of 1.2 k Ω will provide about 20 mA LED current, when run from 24 Vdc.

2.7.3 Digital I/O Command Control

To handle the Input and Outputs, a set of CBx and ABx commands are available for the user. These commands include getting the status and setting/clearing the Input/Outputs.

For more details, refer to the Cobalt CBx Command Protocol Reference Manual, and the Cobalt ABx Fast Command Protocol Reference Manual, both available on the Datalogic Automation web site in the download section of the product page.

To determine which command protocol to utilize, please refer to the list below for the different Cobalt RFID devices.

CBx Protocol

- HF-CNTL-Series Fieldbus and Non Fieldbus models: Industrial Ethernet (IND),

ABx Protocol (Fast and Standard)

- HF-CNTL-Series Serial models: RS232



NOTE

All RS485-based RFID controllers are used in conjunction with Subnet16™ Gateway and Subnet16™ Hub interface modules, which all use the CBx Command Protocol.

3 LED INDICATORS

3.1 FRONT PANEL LEDS

3.1.1 RS232 Models

LED Name	LED Color		LED Description
READY		GREEN	The READY LED is ON after the power up sequence has completed.
RF		AMBER	The RF LED illuminates when RF power is being transmitted by the antenna.
COM		AMBER	The COM (communications) LED flashes ON and OFF when data is being transmitted between the antenna and a tag. When in Continuous Read mode, the COM LED will remain ON and will turn OFF briefly only while data is being read from or written to a tag.

3.1.2 RS485 Models

LED Name	LED Color		LED Description
READY		GREEN	The READY LED is ON after the power up sequence has completed.
RF		AMBER	The RF LED illuminates when RF power is being transmitted by the antenna.
COM		AMBER	The COM (communications) LED flashes ON and OFF when data is being transmitted between the antenna and a tag. When in Continuous Read mode, the COM LED will remain ON and will turn OFF briefly only while data is being read from or written to a tag.
NODE ID		AMBER	The five Node ID LEDs indicate (in Binary, from top to bottom) the current Node ID value assigned to the controller.

3.1.3 INDUSTRIAL Models

LED Name	LED Color		LED Description
READY		GREEN	The READY LED is ON after the power up sequence has completed.
RF		AMBER	The RF LED illuminates when RF power is being transmitted by the antenna.
COM		AMBER	The COM (communications) LED flashes ON and OFF when data is being transmitted between the antenna and a tag. When in Continuous Read mode, the COM LED will remain ON and will turn OFF briefly only while data is being read from or written to a tag.
DEFAULT		AMBER	Default IP Address enabled (192.168.253.110)
CUSTOM		AMBER	User assigned IP Address enabled

3.1.4 DEVICENET Models

LED Name	LED Color		LED Description
READY		GREEN	The READY LED is ON after the power up sequence has completed.
RF		AMBER	The RF LED illuminates when RF power is being transmitted by the antenna.
COM		AMBER	The COM (communications) LED flashes ON and OFF when data is being transmitted between the antenna and a tag. When in Continuous Read mode, the COM LED will remain ON and will turn OFF briefly only while data is being read from or written to a tag.
DEVICENET		GREEN/RED	SOLID GREEN: on-line and connection established. FLASHING GREEN: on-line, but no connections established, or needs commissioning. FLASHING RED: connection timed out, or recoverable fault detected. SOLID RED: unrecoverable fault detected (i.e., duplicate node address).

3.1.5 PROFIBUS Models

LED Name	LED Color		LED Description
READY		GREEN	The READY LED is ON after the power up sequence has completed.
RF		AMBER	The RF LED illuminates when RF power is being transmitted by the antenna.
COM		AMBER	The COM (communications) LED flashes ON and OFF when data is being transmitted between the antenna and a tag. When in Continuous Read mode, the COM LED will remain ON and will turn OFF briefly only while data is being read from or written to a tag.
STATUS		GREEN/RED	SOLID GREEN: initialized. FLASHING GREEN: initialized, diagnostic event(s) present. SOLID RED: exception error
OP MODE		GREEN/RED	SOLID GREEN: on-line, data exchange FLASHING GREEN: on-line, but idle. FLASHING RED (1 FLASH): parametrization error FLASHING RED (2 FLASHES): Profibus configuration error

3.1.6 PROFINET Models

LED Name	LED Color		LED Description
READY		GREEN	The READY LED is ON after the power up sequence has completed.
RF		AMBER	The RF LED illuminates when RF power is being transmitted by the antenna.
COM		AMBER	The COM (communications) LED flashes ON and OFF when data is being transmitted between the antenna and a tag. When in Continuous Read mode, the COM LED will remain ON and will turn OFF briefly only while data is being read from or written to a tag.
MOD STATUS		GREEN/RED	SOLID GREEN: initialized, Normal Operation FLASHING GREEN (1 FLASH): diagnostic event(s) present. FLASHING GREEN (2 FLASHES): blink used for node identification SOLID RED: exception error FLASHING RED (1 FLASH): configuration error FLASHING RED (2 FLASHES): IP address error FLASHING RED (3 FLASH): Station Name error FLASHING RED (4 FLASHES): Internal error
NET STATUS		GREEN	SOLID GREEN: IO Controller connected in RUN FLASHING GREEN: IO Controller connected in STOP
LINK 1 LINK 2		AMBER	SOLID AMBER: Profinet link established

4 CONFIGURATION METHODS

There are several configuration methods available for your controller depending on the interface type and application:

- Configuration Tag
- Configuration Tools: Cobalt Dashboard™ and C-Macro Builder™
- Command Protocol

4.1 CONFIGURATION TAG

A configuration tag is included with your HF-Series controller. This can be used to reset all HF-series controllers to their factory default configuration settings.

For Subnet16™ models (HF-CNTL-485-x2), this tag can also be used to set the Node ID of each controller in the network.



Figure 42 - HF-Series Configuration Tag

4.1.1 Node ID Configuration Using Configuration Tags

Only RS485-based RFID controllers can be connected to a Gateway's Subnet network and each must be assigned a unique Node ID value between 1 and 16.

When an RFID controller is connected to the Gateway's Subnet network, the Gateway will query the new controller to obtain certain configuration values (specifically the Node ID number). If the Gateway does not detect a Node ID conflict, it will "allow" the RFID controller onto the Subnet network.

By using the **Cobalt HF Configuration Tag** that is included with each RS485-based Cobalt HF-Series RFID Controller, the Node ID value can be dynamically assigned by the Gateway or can be manually assigned by the user.

For the Gateway to dynamically assign a Node ID value to a controller, the controller must first be initialized with the Node ID value of zero. This is the equivalent of having no Node ID assigned.

**NOTE**

All Datalogic Automation RS485-based controllers ship with their Node ID value set to 0.

When a powered controller (that is set to Node ID 0) is connected to the Subnet, it will not initially be recognized by the Gateway until the Configuration Tag is placed in the antenna's RF field. After a few seconds the controller will display its new assigned Node ID value in binary code from right to left or (top to bottom) using the five amber Node LEDs on the controller, see Figure B, 7.

When dynamically assigning a Node ID value for a new controller, the Gateway will either assign the next available Node ID value or the value that the Gateway recognizes as offline or "*missing*" – that is, a Node ID value that previously existed, but has since disappeared from the network.

Because the Gateway stores a backup of each Subnet Node's configuration, should an RFID controller ever fail, a replacement controller can be installed quickly and easily. The new controller will be automatically assigned the same Node ID value and configuration as the replaced controller, provided the Configuration Tag is introduced to the antenna field after startup and then removed.

**NOTE**

Avoid that the configuration tag is simultaneously read by more than one controller.

4.2 CONFIGURATION TOOLS

Datalogic Automation offers the following powerful RFID configuration utilities for Microsoft Windows 2000, XP, Vista and 7 systems:

- **Cobalt Dashboard™**
- **C-Macro Builder™**

These configuration tools can be downloaded from the Datalogic Automation website: www.automation.datalogic.com

4.2.1 Configuration Using Cobalt Dashboard™

The **Cobalt Dashboard™ Utility** is a software application that allows users to view, modify, save and update the configuration settings of their Cobalt controllers. Follow the instructions below to operate the *Cobalt Dashboard Utility* and to set the Cobalt device's configuration.

1. Install the Controller as described in the relevant sub-paragraph in 2.6.
2. Connect the Controller to your PC, power up and wait for the boot procedure to finish.
3. Run the *Cobalt Dashboard™*.
4. From the Connection screen, choose your controller from the list.

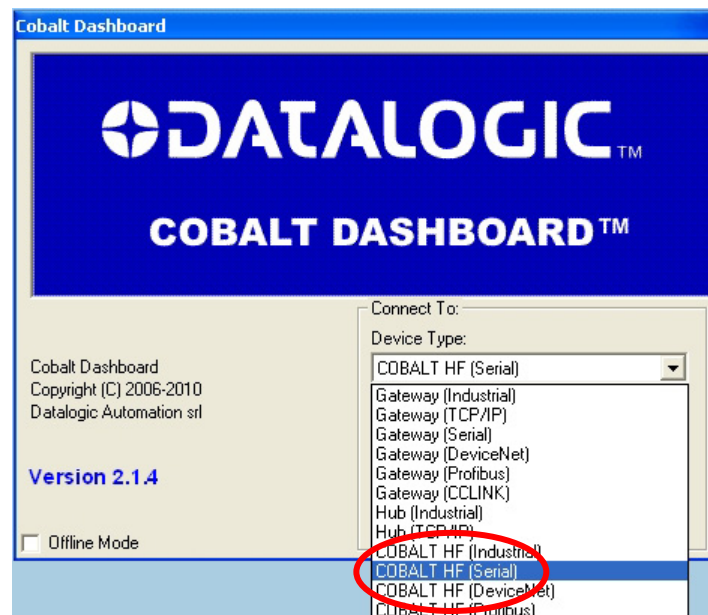


Figure 43 - Cobalt Dashboard™ HF RS232 Controller Selection

5. Choose the appropriate COM port and Baudrate, (or IP Address for Ethernet models); then click "Connect".

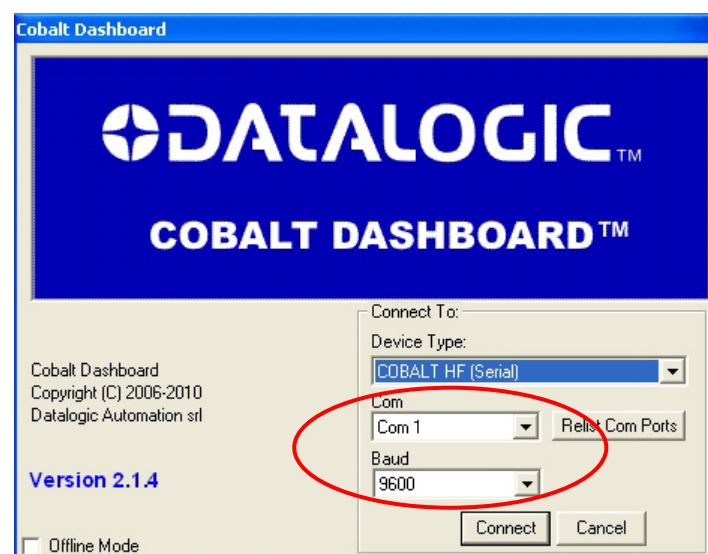


Figure 44 - Cobalt Dashboard™ COM Port and Baudrate Selection

The Dashboard should send some commands to retrieve device and configuration information from the device. If communications are set up correctly, the device configuration area within the Cobalt Dashboard should now look something like this:

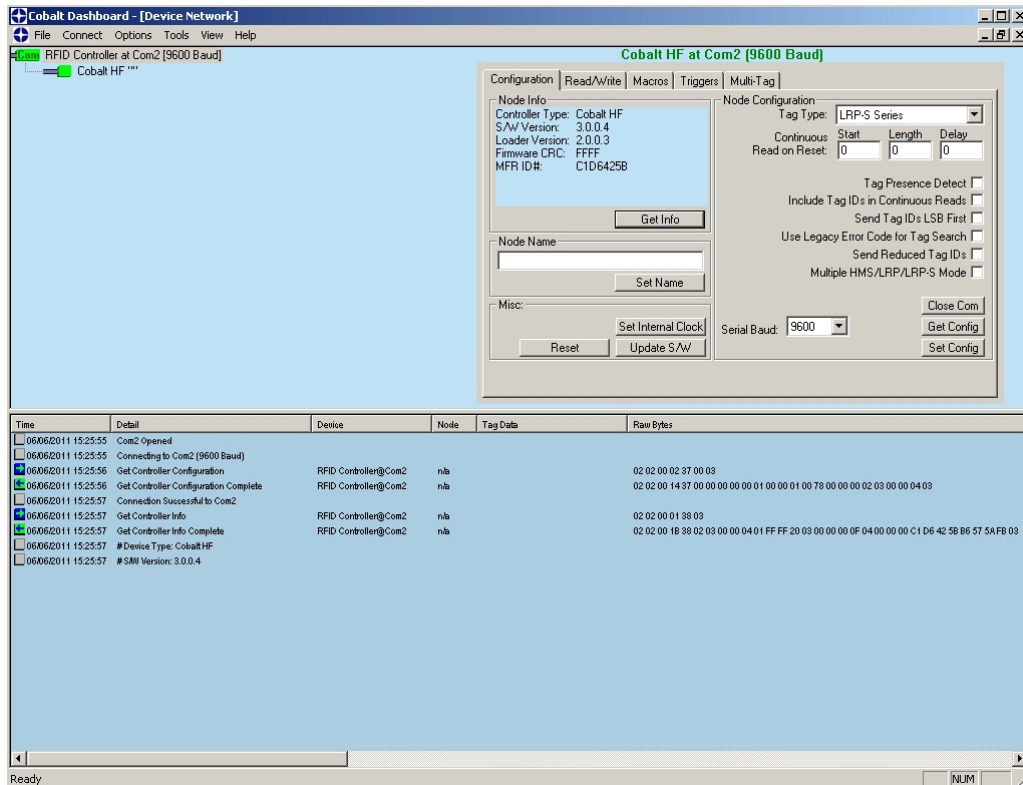


Figure 45 - Cobalt Dashboard™ HF RS232 Controller Configuration

See the Cobalt Dashboard™ User's Manual for more configuration details.

4.2.2 Software Upgrades Using Cobalt Dashboard™

The Cobalt Dashboard™ utility also allows for controller software upgrades.



NOTE

For the HF-Series Controllers, software upgrades/downgrades can only be made within the same major release family (i.e. 2.xx <> 2.xy). Do not attempt software upgrades/downgrades between major releases (i.e. 2.xx <> 3.xx).

See the Cobalt Dashboard™ User's Manual for more details on software upgrades.

4.2.3 Creating and Using RFID Macros with C-Macro Builder™

What are RFID Command Macros?

RFID Command Macros are a powerful feature of Datalogic Automation Cobalt Controllers. Macros are simple programs that direct a controller to execute multiple pre-programmed instructions.

Because macros reside within the controller's internal memory, they can be programmed to instruct the controller to automatically read and/or write a specified set of data to an RFID tag without the controller ever having to receive a command from the host. In fact, the controllers do not even require a connection to a host in order to execute macros.

Each macro can contain up to 255 bytes of data and each supported controller can store up to eight macros at a time. Though they are stored locally on the controller, macros are also backed up in the Gateway's flash memory as well.

Why use macros?

The power of macros is in distributed intelligence, the reduction in network bus traffic and the ability to accelerate routine decision making at the point of data collection.

What can macros do?

In addition to the automated reading and writing of data, macro capabilities include:

- The ability to write time stamps to RFID tags
- The ability to filter command responses to only those of interest to the host (such as when an error occurs or when a tag has arrived in the RF field)
- The ability to harness powerful logic and triggering capabilities such as; read, write, start/stop continuous read, data compare, branch, transmit custom string, and set outputs.

What is a macro trigger?

Macros are initiated by "triggers." Triggers can be configured in numerous ways. A simple command from the host, such as "execute macro number three" can be considered a trigger. Triggers can be configured, for example, to activate a macro when a tag enters or leaves a controller's RF field.

Datalogic Automation RFID controllers can store up to eight separate triggers in addition to the eight macros they can also house. Any trigger can activate any of the eight stored macros.

How are macros created?

Macros are created using the powerful, yet simple, C-Macro Builder™ utility from Datalogic Automation. The easy to use GUI allows the user to create powerful RFID macro programs quickly and easily.

When used with Datalogic Automation Cobalt Dashboard™ utility, users can effortlessly download, erase, and manage their macros and triggers, as well as set the operational configurations of their RFID controllers and Subnet16™ Gateways.

Which communication interfaces support the use of macros?

Macros are supported on the following Cobalt Controllers: Ethernet, Profibus, Profinet, DeviceNet, RS232 and USB interfaces.

What happens to existing Macros if a controller must be replaced?

When using a Subnet16™ Gateway, users do not need to worry. Macros and triggers normally residing in an RFID controller's flash memory are always backed up in the Gateway's flash memory as well. Therefore, if a controller should ever require replacement, all existing macro and trigger settings are automatically exported from the Gateway to the new RFID controller.

In short, when an RFID controller is initially connected to the Gateway, macro and trigger data from the controller's flash memory is compared to the macro and trigger data backed up in the Gateway from the previous RFID controller. If the data does not match that which is stored on the Gateway, the controller's flash memory will be overwritten with the backed up data stored in the Gateway's flash memory.

How can I learn more about the Dashboard and C-Macro Builder?

More information regarding macros, triggers, uploading, downloading, configuring and monitoring Datalogic Automation RFID equipment is available in the respective User's Manuals for these products, which are available on the Datalogic Automation website at:

www.automation.datalogic.com

C-Macro Builder™ is an easy to use GUI-driven utility for Windows that allows users to create powerful RFID command macro programs.

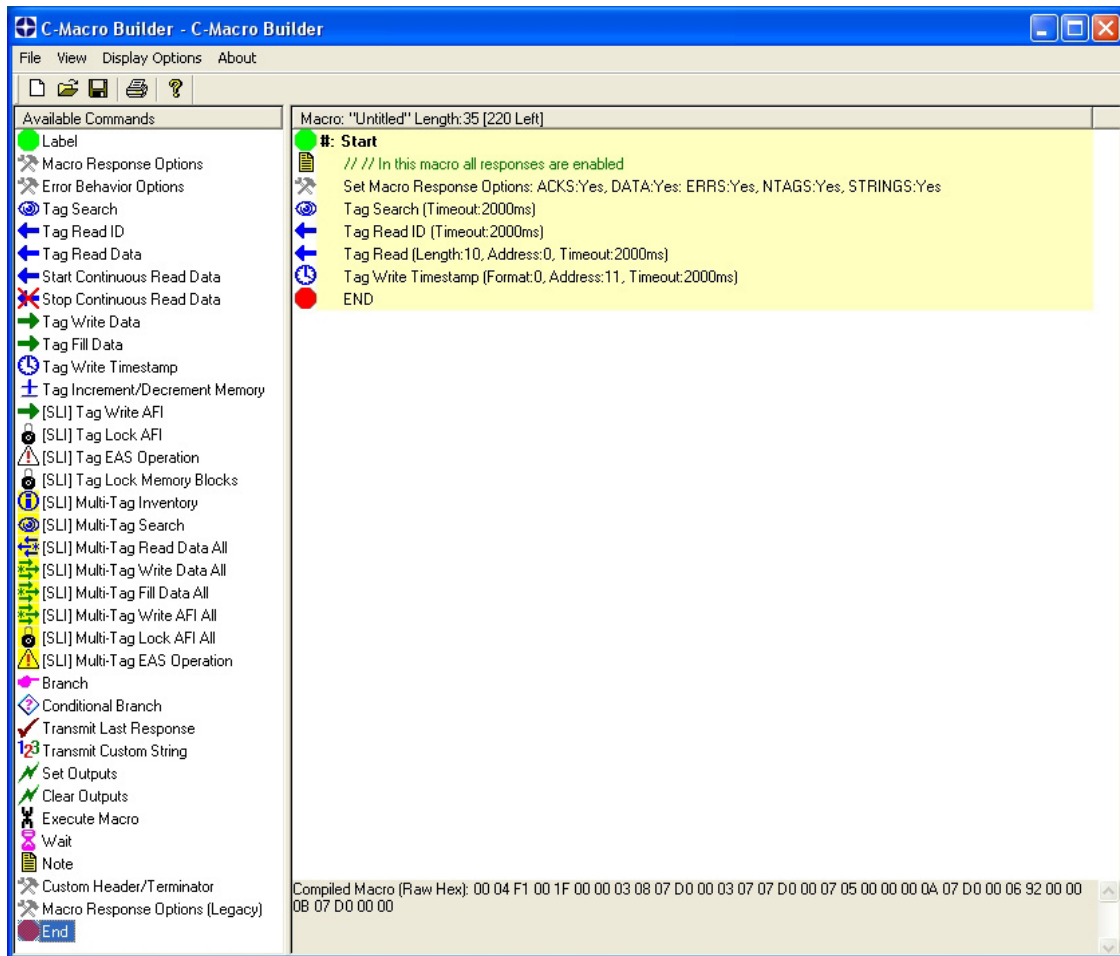


Figure 46 - C-Macro Builder™



NOTE

For specific information regarding the configuration and use of either of these utilities, please see the accompanying documentation included when downloading each software application.

4.3 COMMAND PROTOCOLS

HF-Series controllers can be directly programmed using a proprietary command protocol over the specific host interface. This is useful for controllers connected to a PLC over a Fieldbus network (i.e. DeviceNet, Profibus, Ethernet/IP, Profinet, etc.).

To determine which command protocol to utilize, please refer to the list below for the different Cobalt RFID devices.

CBx Protocol

- HF-CNTL-Series (Fieldbus and Non-Fieldbus) models: Industrial Ethernet (IND), DeviceNet (DNT), Profibus (PBS), Profinet (PNT)

ABx Protocol (Fast and Standard)

- HF-CNTL-Series Serial models: RS232



NOTE

All RS485-based RFID controllers are used in conjunction with Subnet16™ Gateway and Subnet16™ Hub interface modules, which all use the CBx Command Protocol.

Refer to the specific Command Protocol Reference Manual for details.

5 ETHERNET/IP INTERFACE



For Cobalt HF-CNTL-IND-x2 models.

NOTE

- Users of the *Cobalt Dashboard* utility should exit the application before attempting communications between the Industrial Cobalt and an EtherNet/IP host Programmable Logic Controller (PLC).
- When installing the Controller for communication over EtherNet/IP, the ODVA Guidelines for EtherNet/IP Media System installation should be followed (refer to www.odva.org, ODVA **PUB00148R0** (Pub 148), EtherNet/IP Media Planning and Installation Manual, 2006 ODVA).
- Follow ODVA recommendations for switching and wiring Ethernet/IP.
- If the Ethernet/IP network enables I/O Messaging for remote I/O, etc., or if other UDP traffic is present, then the Controller must be protected by a switch that incorporates IGMP Snooping or a VLAN.

The Cobalt HF-CNTL-IND-x2 model is designed to support many common Industrial Ethernet protocols and can be implemented in a wide variety of existing host / PLC applications. One such popular Ethernet protocol is **Ethernet/IP (EIP)**.

This chapter focuses on the process of setting up the Cobalt Industrial RFID Controller to communicate (via Ethernet/IP) with a ControlLogix Programmable Logic Controller (PLC).

Also in this chapter are descriptions of the Datalogic **HTTP Server** and **OnDemand Utilities**, as well as systematic instructions to help configure the Cobalt Industrial RFID Controller for Ethernet/IP environments.



NOTE

This manual assumes that users are already familiar with Ethernet/IP, industrial Ethernet communications protocols and programmable logic controller technologies. For specific information regarding the protocol used by your particular RFID application, please refer to the appropriate documentation from your host / PLC program provider.

5.1 ETHERNET/IP CONFIGURATION OVERVIEW

Based upon on the standard TCP/IP protocol suite, EtherNet/IP is a high-level application layer protocol for industrial automation applications that uses traditional Ethernet hardware and software to define an application layer protocol that structures the task of configuring, accessing and controlling industrial automation devices.

Ethernet/IP classifies Ethernet nodes as predefined device types with specific behaviors. The set of device types and the EIP application layer protocol is based on the Common Industrial Protocol (CIP) layer used in ControlNet. Building on these two widely used protocol suites, EtherNet/IP provides a seamlessly integrated system from the RFID Subnet network to the Host and enterprise networks.

The Cobalt is designed to communicate as an EtherNet/IP client device, which will receive and execute RFID commands issued by the host / PLC (acting as EtherNet/IP Server).

Paragraphs 5.3 through 5.7 contain instructions that will help you accomplish the following:

- Assign the Cobalt an IP address via *HTTP Server*
- Configure the Cobalt's Subnet Node via *OnDemand Utilities*
- Create "*Controller Tags*" in the PLC
- Verify PLC and Cobalt Subnet Node connectivity

5.2 HTTP SERVER & ONDEMAND PLC SUPPORT

Below is a partial list of the programmable logic controllers that are supported by the Datalogic *HTTP Server* and *OnDemand Utilities*:

- ControlLogix – OnDemand supports all current versions
- RA's PLC5E releases:
 - Series C, Revision N.1
 - Series D, Revision E.1
 - Series E, Revision D.1
- PLC5 "Sidecar" Module Series B, Revision A with EIP support
- SLC5/05 releases:
 - Series A with firmware revision OS501, FRN5
 - All Series B and Series C PLC Controllers

5.3 HTTP SERVER AND ONDEMAND UTILITIES

Embedded in the Cobalt *HF-CNTL-IND-02* is an **HTTP Server**, which provides a Website-like interface and a suite of configuration tools.

Through the use of the Cobalt's *HTTP Server*, users can access, modify and save changes to the unit's Industrial Ethernet configuration, IP address, and *OnDemand* mode settings.

The *OnDemand Utilities* will be used later in this chapter to link the Cobalt to specific *Controller Tags* as defined in Rockwell Automation's (RA) ControlLogix PLC.

**CAUTION**

Disable any firewall services affecting or running locally on the host computer. Firewalls can potentially block communications between the Cobalt and the host and/or PLC.

**NOTE**

*In ControlLogix, a “**Controller Tag**” is a small block of internal memory that is used to hold outgoing (command) and incoming (response) data. Within each controller tag, information is stored in two-byte segments, known as registers or “words.”*

OnDemand is the Datalogic approach to adding *Change of State* messaging to ControlLogix and legacy support for *RA PLC5E* and *RA SCL5/05* programmable logic controllers.

5.4 IP CONFIGURATION VIA HTTP SERVER

To configure the Cobalt for Ethernet communications, begin by assigning the controller a locally compatible IP address.

Through a standard Web browser, you can utilize the Cobalt's *HTTP Server* to access an embedded suite of controller configuration tools, called the "**OnDemand Utilities**." Among its features is the ability to modify and save changes to the controller's IP address, which is stored internally on the Cobalt.

Cobalt Industrial Ethernet RFID Controller - Default IP Address:
192.168.253.110

Setting the Cobalt IP Address

To set the Cobalt's IP address using the *HTTP Server*, follow the steps below:

1. Open a Web browser on the PC.
2. In the URL address field, enter the Cobalt's IP address (*192.168.253.110 = factory default*).
3. Press **ENTER**.

The *HTTP Server - Main Page* will be displayed.

HTTP Server – Main Page



HF-CNTL-IND v1.0.A
Industrial Ethernet RFID Control

OnDemand Config

OnDemand Status

Serial Config

EMS Web Page

Description

Station 1

[Edit](#)

Network Settings

IP Address: 192.168.253.110

Subnet Mask: 255.255.255.0

Gateway IP Address: 0.0.0.0

[Edit](#)

Network Status

MAC Address: 00:40:9D:26:D9:70

Revision: 1.27

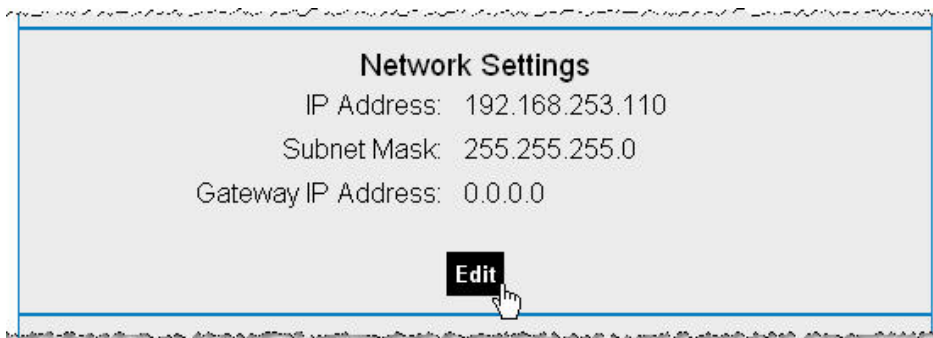
Link Duplex: FULL

Link Speed: 100 MBPS

Figure 47 - The HTTP Server - Main Page

The *HTTP Server - Main Page* lists the IP address and network settings currently stored on the Cobalt.

- Click the button labeled **"EDIT"**, located below **"Network Settings."**



The IP Configuration Page will be displayed.

IP Configuration Page

The *IP Configuration Page* is used to modify and save changes to the IP Address, Subnet Mask and (Network) Gateway IP Address.

A screenshot of the "IP Configuration" page. The title "IP Configuration" is in large blue font. Below it are three input fields: "IP Address:" with value "192.168.253.110", "Subnet Mask:" with value "255.255.255.0", and "Gateway IP Address:" with value "0.0.0.0". Below the fields are two buttons: "Save Settings" and "Cancel Changes". At the bottom, there is a note in italics: "(The unit resets automatically when settings are modified)" and a blue underlined link: "[Main Page](#)".

Figure 48 - The IP Configuration Page

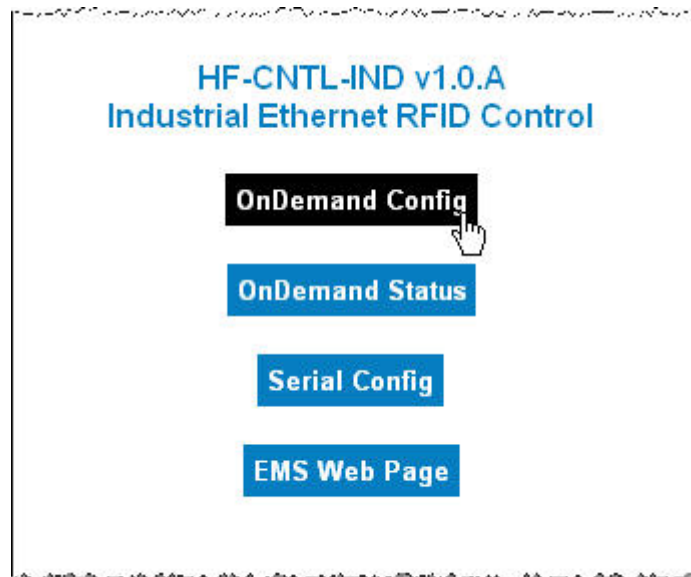
- In the fields provided, enter your new IP configuration values for the Cobalt.
- Click the **"Save Settings"** button to store your new IP configuration, then cycle power to the controller to store the changes in the main memory. The Ethernet module will reset and your IP changes will be implemented.
- After the Cobalt has restarted, verify the new IP configuration by opening a Web browser and manually entering the Cobalt's new IP address in the URL field. If successful, you should arrive back at the *HTTP Server – Main Page*.

5.5 ONDEMAND CONFIGURATION FOR ETHERNET/IP

Now that you have configured the Cobalt's IP address, you will need to use the embedded *HTTP Server* to access the Cobalt's **OnDemand Configuration Page**. Through the use of the *OnDemand Configuration Page*, the Cobalt can be configured to communicate with a *ControlLogix PLC*.

To configure the Cobalt's *OnDemand Configuration* settings, follow the steps below:

1. Open a Web browser on the host and enter the Cobalt's new IP address in the URL field. The *HTTP Server – Main Page* will be displayed.
2. At the *HTTP Server – Main Page*, click the button labeled "**OnDemand Config.**"



The *OnDemand Configuration Page* will be displayed.

OnDemand Configuration Page

The *OnDemand Configuration Page* allows you to modify the settings of the Cobalt's Node.

OnDemand Configuration

PLC Type:

PLC IP Address:

PLC Slot Number:

Read Delay: 10ms ticks (0-6000)

Writes transfer data **from** the ExLink **to** the PLC.
 Reads transfer data **from** the PLC **to** the ExLink.

Write Size and Read Size Range is **0-100 words** (0 disables).

Write Tag Name and Read Tag Name are the Tag Names
 (i.e. "TagA") for the ControlLogix and CompactLogix
 and the PCCC File Number and Offset
 (i.e. "N7:0") for the PLC5E, SLC5/05 and MicroLogix.

Enable Node	Write Size	Write Tag Name	Read Size	Read Tag Name
☐ 01				
☐ 02				

Figure 49 - The OnDemand Configuration Page

- In the upper portion of the *OnDemand Configuration Page*, select a **PLC Type** from the drop-down menu.

OnDemand Configuration

PLC Type:

PLC IP Address:

PLC Slot Number:

Read Delay: 10ms ticks (0-6000)

Figure 50 - The OnDemand Configuration Page

- Enter the PLC's IP address.
- For the **PLC Slot Number**, enter a value between 0 and 255. The PLC Slot Number indicates the location in your PLC rack where the controller module is installed (normally slot 0 for ControlLogix).

6. In the **Read Delay** field, enter a value between 0 and 6000. This number specifies (in 10ms “ticks”) how frequently the Cobalt will poll the PLC for the presence of new data. (Note: a value of 6000 = 60 seconds; zero = disable).
7. In the column labeled “**Enable Node**,” place a check in the box for **Node 01**. Other Nodes listed on this page are not supported by the Cobalt –IND.

Enable Node	Write Size	Write Tag Name	Read Size	Read Tag Name
☒ 01	100	EMS_WRITE1	100	EMS_READ1

8. **Write Size:** Enter a value between 1 and 100 (or 0 to disable) for the **Write Size**. The Write Size represents the maximum number of 2-byte “words” that the Cobalt will attempt to write to PLC memory during a single write cycle. (Note: to accommodate message handshaking overhead, the actual data size required by the PLC is three words larger than the value specified in this field).
9. **Write Tag Name:** For *ControlLogix* systems, specify a **Write Tag Name** that is 40 characters or less (for example *EMS_WRITE1*, for Node 01). The Write Tag Name is a user defined description or title for the area of memory in the PLC where host-bound data will be written for the Cobalt. (Note: the Write Tag Name is not to be confused with writing to an RFID transponder, which is often referred to as “writing to a tag”).

OR

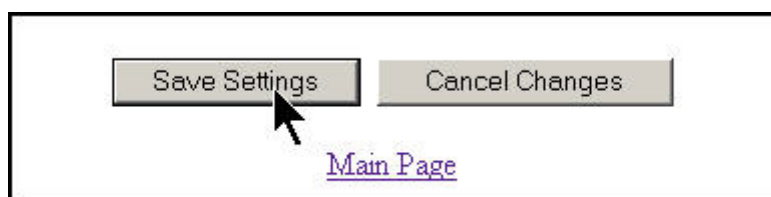
Write Tag Name: For *PLC5E*, *SLC5/05* and *MicroLogix* systems, enter the **PCCC File Number and Offset** (for example *N7:0*) in the *Write Tag Name* field. Together these values identify the location in the PLC’s Status File where host-bound data will be written for the Cobalt.

10. **Read Size:** Enter a value between 1 and 100 (or 0 to disable) for the **Read Size**. The Read Size represents the maximum number of 2-byte “words” that the Cobalt will attempt to retrieve from PLC memory during a single read cycle. (Note: to accommodate message handshaking overhead, the actual data size required by the PLC is three words larger than the value specified in this field).
11. **Read Tag Name:** For *ControlLogix* systems, specify a **Read Tag Name** that is 40 characters or less (for example *EMS_READ1*, for Node 01). The Read Tag Name is a user defined description or title for the area of memory in the PLC from which the Cobalt will retrieve data.

OR

Read Tag Name: For *PLC5E*, *SLC5/05* and *MicroLogix* systems enter the **PCCC File Number and Offset** in the *Read Tag Name* field. Together these values indicate the location in the PLC’s Status File from which the Cobalt will retrieve data.

12. After entering the proper information for Node 01, click the **Save Settings** button located at the bottom of the page.



The *OnDemand Status Page* will be displayed.

13. At the *OnDemand Status Page*, click the link labeled “**Main Page**” to return to the *HTTP Server – Main Page*.

OnDemand Status				
Main Page				
PLC Read TCP Status: Disconnected				
PLC Write TCP Status: Disconnected				
NODE #	READ COUNTS	READ STATUS	WRITE COUNTS	WRITE STATUS
01	0		0	

5.6 CONFIGURING PLC CONTROLLER TAGS

After you have configured the Cobalt's Node via the *OnDemand Configuration Page*, open your PLC program (i.e. RSLogix 5000) and, if you have not already done so, define two **Controller Tags** (a **Write Tag** and a **Read Tag**).

Controller Tag Naming

Controller Tags need to be assigned a name and size. Be sure to use the same **Write Tag Name** and **Read Tag Name** that you specified in the *OnDemand Node Configuration* (i.e., EMS_WRITE1 and EMS_READ1).

Controller Tag Size

Due to handshaking overhead, *Controller Tags* must have the size capacity to store an integer array equal to your previously specified **Write/Read Size + three words**.

So for example, if the *Read Size* you specified earlier was 100 words, the corresponding *Read Tag* in the PLC must be able to store an array of 103 integers.

Controller Tags - SAMPLE_435NBA(controller)						
Scope:	SAMPLE_435NBA(c	Show:	Show All	Sort:	Tag Name	
Tag Name	Value	Force Mask	Style	Type	Descrip	
+ EMS_READ1	{...}	{...}	Hex	INT [103]		
EMS_TEST				INT		

- The **Write Tag** holds messages and response data generated by the Cobalt that is bound for the host or PLC.
- The **Read Tag** holds RFID commands and instructions intended for the Cobalt.



NOTE

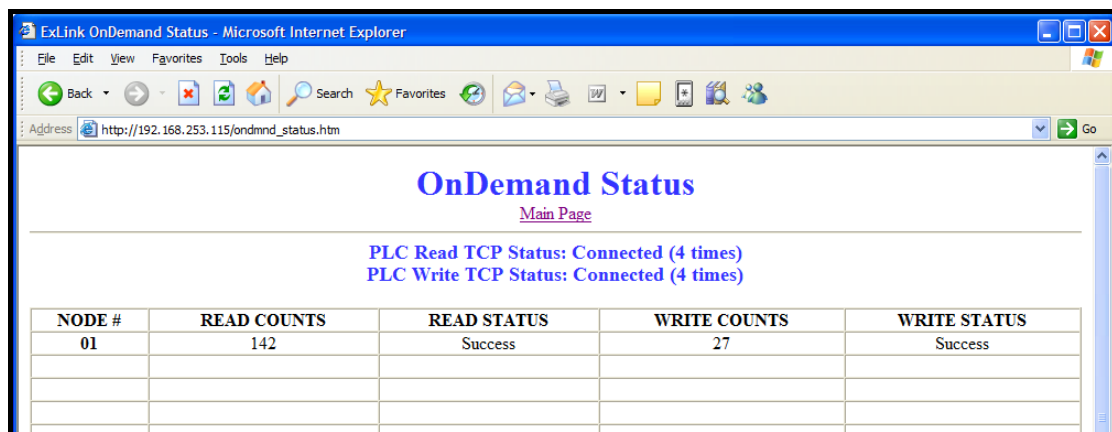
The Cobalt should already be linked to the proper Write Tag and Read Tag via the *OnDemand Utilities - OnDemand Configuration Page*).

After creating and defining a *Write Tag* and a *Read Tag* for the Cobalt, return to the Cobalt's *HTTP Server – Main Page* to continue.

5.7 CHECKING ONDEMAND STATUS

Now that you have configured the Cobalt's Node and defined corresponding *Write* and *Read Tags* in the PLC, the last step is to check the communication status between the Cobalt and the PLC.

Return to the Cobalt's *HTTP Server - Main Page* and click the link labeled "**OnDemand Status**." The *OnDemand Status Page* will be displayed.



NODE #	READ COUNTS	READ STATUS	WRITE COUNTS	WRITE STATUS
01	142	Success	27	Success

Figure 51 - The OnDemand Status Page

The OnDemand Status Page provides statistical information regarding the connection status of the Cobalt. This information can be used to verify that read and write connections between the Cobalt and the PLC have been established successfully.

- **Read Counts:** this value indicates the number of times the Cobalt has checked the PLC for new data.
- **Write Counts:** this value indicates the number of times the Cobalt has provided data to the PLC.



NOTE

*That under Ethernet/IP, the host (and/or PLC) acts as the server. However, additional messaging instructions are not required on the part of the host because the Cobalt will automatically poll the Read Tag in the PLC at the interval specified by the **Read Delay** value set via the OnDemand Configuration Utility.*

There is no delay parameter when writing data to the PLC, as the Cobalt delivers all PLC-bound data immediately after it is generated.

If you configured a low Read Delay value, the Read Counts on the OnDemand Status Page will accumulate rapidly. This occurs because a low Read Delay value instructs the Cobalt to poll the PLC for new data more frequently.



CAUTION

If the Cobalt and PLC do not successfully establish a connection, cycle power to the Cobalt and verify that Ethernet/IP services are running properly on the PLC. If that does not resolve the issue, restart Ethernet/IP services on the PLC and the 1756-ENBT module.

5.8 VERIFYING DATA EXCHANGE WITH RSLOGIX 5000

At this point, communication between the Cobalt and the PLC should be properly configured and a connection established. You can verify the exchange of information between devices using RSLogix 5000.

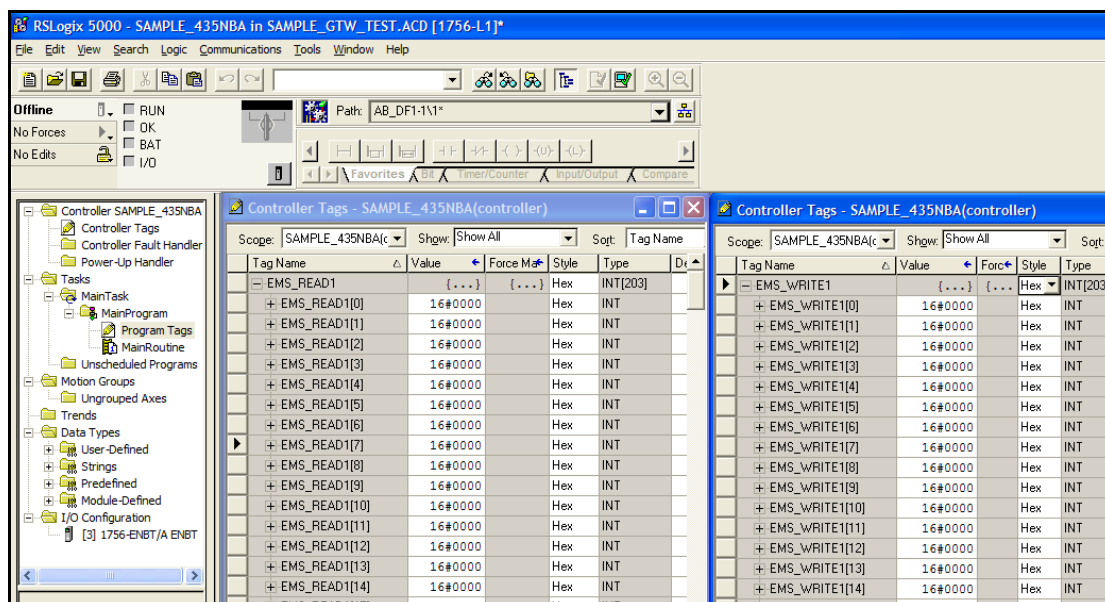


Figure 52 - RSLogix 5000

5.8.1 Ethernet/IP Handshaking

To ensure that messages to and from the Cobalt are properly delivered and received, a handshaking mechanism has been implemented that uses a pair of dedicated words in the exchange. The first two words in each *Controller Tag* are dedicated to handshaking.

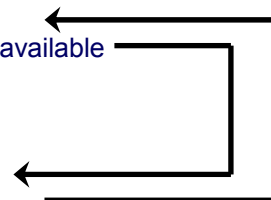
When new information is generated, the producing device (*Data Producer*) will increment a counter in one of the *Controller Tags*. After identifying the new data, the consuming device (*Data Consumer*) will copy that same counter value to a different Controller Tag location, which lets the Data Producer know that the information has been processed by the Data Consumer.

WRITE TAG (where responses are written by the Cobalt)

EMS_Write1 [0] = (2) the Cobalt copies counter here to ACK
 EMS_Write1 [1] = (3) the Cobalt increments this counter to signal response available
 EMS_Write1 [2] = Data Size
 EMS_Write1 [3-102] = Data

READ TAG (where commands are retrieved by the Cobalt)

EMS_Read1 [0] = (4) PLC copies the counter here to ACK the response
 EMS_Read1 [1] = (1) PLC increments this counter after writing a command
 EMS_Read1 [2] = Data Size
 EMS_Read1 [3-102] = Data



5.8.2 Ethernet/IP Handshaking Example

In the example below, **EMS_READ1** is the name of the Read Tag and **EMS_WRITE1** is the name of the Write Tag.



[0] indicates the first word, [1] indicates the second word in a controller tag.

NOTE

1. The PLC writes the command to the Read Tag (EMS_READ1) and then increments the counter in EMS_READ1 [1]
2. The counter in EMS_READ1 [1] is copied by the Cobalt to EMS_WRITE1 [0] which acknowledges that the command has been received.

Tag Name	Value	Force Mask	Style	Type
EMS_READ1	{...}	{...}	Hex	INT[2]
EMS_READ1[0]	16#0005		Hex	INT
EMS_READ1[1]	16#0004		Hex	INT
EMS_READ1[2]	16#0006		Hex	INT
EMS_READ1[3]	16#aa07		Hex	INT
EMS_READ1[4]	16#0001		Hex	INT
EMS_READ1[5]	16#07d0		Hex	INT
EMS_READ1[6]	16#0000		Hex	INT
EMS_READ1[7]	16#0000		Hex	INT
EMS_READ1[8]	16#0000		Hex	INT
EMS_READ1[9]	16#0000		Hex	INT
EMS_READ1[10]	16#0000		Hex	INT
EMS_READ1[11]	16#0000		Hex	INT
EMS_READ1[12]	16#0000		Hex	INT
EMS_READ1[13]	16#0000		Hex	INT

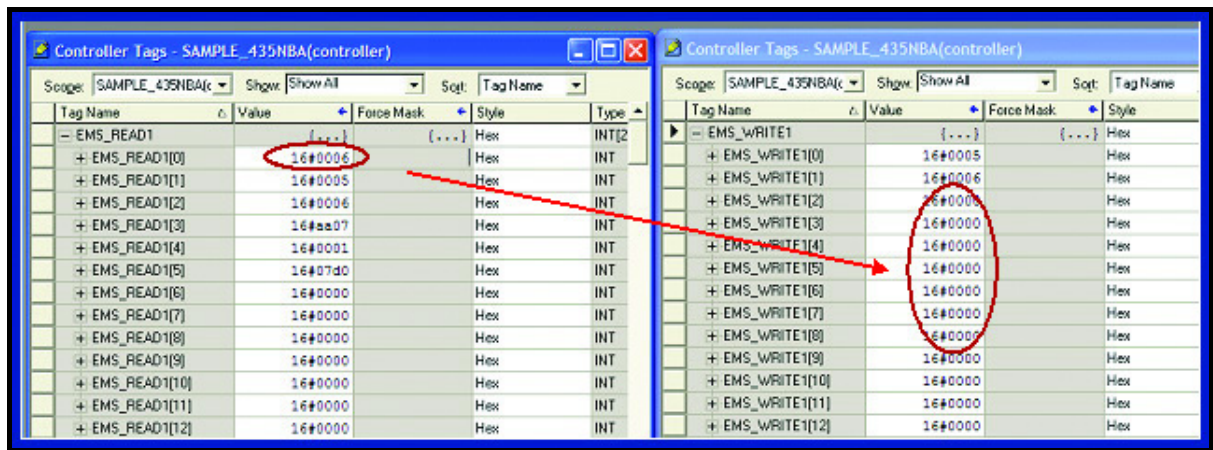
Tag Name	Value	Force Mask	Style	Type
EMS_WRITE1	{...}	{...}	Hex	
EMS_WRITE1[0]	16#0004		Hex	
EMS_WRITE1[1]	16#0005		Hex	
EMS_WRITE1[2]	16#0000		Hex	
EMS_WRITE1[3]	16#0000		Hex	
EMS_WRITE1[4]	16#0000		Hex	
EMS_WRITE1[5]	16#0000		Hex	
EMS_WRITE1[6]	16#0000		Hex	
EMS_WRITE1[7]	16#0000		Hex	
EMS_WRITE1[8]	16#0000		Hex	
EMS_WRITE1[9]	16#0000		Hex	
EMS_WRITE1[10]	16#0000		Hex	
EMS_WRITE1[11]	16#0000		Hex	
EMS_WRITE1[12]	16#0000		Hex	
EMS_WRITE1[13]	16#0000		Hex	

3. Following execution of the command, the Cobalt copies the response to EMS_WRITE1 (the Write Tag) and increments the counter in EMS_WRITE1 [1]. This signals that there is new data for the PLC (the Cobalt generated response, in this case).

Tag Name	Value	Force Mask	Style	Type
EMS_READ1	{...}	{...}	Hex	INT[2]
EMS_READ1[0]	16#0005		Hex	INT
EMS_READ1[1]	16#0005		Hex	INT
EMS_READ1[2]	16#0006		Hex	INT
EMS_READ1[3]	16#aa07		Hex	INT
EMS_READ1[4]	16#0001		Hex	INT
EMS_READ1[5]	16#07d0		Hex	INT
EMS_READ1[6]	16#0000		Hex	INT
EMS_READ1[7]	16#0000		Hex	INT
EMS_READ1[8]	16#0000		Hex	INT
EMS_READ1[9]	16#0000		Hex	INT
EMS_READ1[10]	16#0000		Hex	INT
EMS_READ1[11]	16#0000		Hex	INT
EMS_READ1[12]	16#0000		Hex	INT
EMS_READ1[13]	16#0000		Hex	INT

Tag Name	Value	Force Mask	Style	Type
EMS_WRITE1	{...}	{...}	Hex	
EMS_WRITE1[0]	16#0005		Hex	
EMS_WRITE1[1]	16#0006		Hex	
EMS_WRITE1[2]	16#000a		Hex	
EMS_WRITE1[3]	16#aa07		Hex	
EMS_WRITE1[4]	16#0601		Hex	
EMS_WRITE1[5]	16#0204		Hex	
EMS_WRITE1[6]	16#0009		Hex	
EMS_WRITE1[7]	16#3408		Hex	
EMS_WRITE1[8]	16#e004		Hex	
EMS_WRITE1[9]	16#0100		Hex	
EMS_WRITE1[10]	16#000f		Hex	
EMS_WRITE1[11]	16#f0f0		Hex	
EMS_WRITE1[12]	16#0000		Hex	
EMS_WRITE1[13]	16#0000		Hex	

4. After the PLC has processed the response information, it copies the counter from EMS_WRITE1 [1] to EMS_READ1 [0] which signals to the Cobalt that the PLC has retrieved the response data.



- The data will then be cleared from EMS_WRITE1. After which the Cobalt will be ready to receive another command.

5.9 ETHERNET/IP: OBJECT MODEL

The **Object Model** is the logical organization of attributes (parameters) within classes (objects) and services supported by each device.

Objects are broken down into three categories: **Required Objects**, **Vendor Specific Objects** and **Application Objects**.

- Required Objects are classes that must be supported by all devices on EtherNet/IP. The Cobalt has six Required Objects.
- Vendor Specific Objects are classes that add attributes and services that do not fit into the Required Objects or Application Objects categories. The Cobalt has two Vendor Specific Objects.
- Application Objects are classes that must be supported by all devices using the same profile. An example of a profile is a Discrete I/O device or an AC Drive. This ensures that all devices with the same profile have a common look on the network.

Data Type Definition Table

EtherNet/IP was designed by the **Open Device Vendors Association (ODVA)** as an open protocol. The following table contains a description of the data types used by ODVA that are also found in this chapter.

Data Type	Description
USINT	Unsigned Short Integer (8-bit)
UINT	Unsigned Integer (16-bit)
UDINT	Unsigned Double Integer (32-bit)
STRING	Character String (1 byte per character)
BYTE	Bit String (8-bits)
WORD	Bit String (16-bits)
DWORD	Bit String (32-bits)

5.9.1 Ethernet/IP Required Objects

Under Ethernet/IP, there are **six Required Objects**:

- Identity Object (0x01)
- Message Router Object (0x02)
- Assembly Object (0x04)
- Connection Manager Object (0x06)
- TCP Object (0xF5)
- Ethernet Link Object (0xF6)

Identity Object (0x01 - 1 Instance)

Class Attributes

Attribute ID	Name / Description	Data Type	Default Data Value	Access Rule
1	Revision	UINT	1	Get

Instance Attributes

Attribute ID	Name / Description	Data Type	Default Data Value	Access Rule
1	Vendor Number	UINT	50 DEC	Get
2	Device Type	UINT	0x0C	Get
3	Product Code Number	UINT	6102 DEC	Get
4	Product Major Revision Product Minor Revision	USINT USINT	01 25	Get
5	Status Word (see below for definition)	WORD	See Below	Get
6	Serial Number	UDINT	Unique 32 Bit Value	Get
7	Product Name: Product Name Size Product Name String	USINT USINT[26]	HF-CNTL-IND-x2 06 "Cobalt"	Get

Status Word

Bit	Bit = 0	Bit = 1
0	No I/O Connection	I/O Connection Allocated
1 – 15	Unused	Unused

Common Services

Service Code	Implementation		Service Name
	Class Level	Instance Level	
0x0E	Yes	Yes	Get Attribute Single
0x05	No	Yes	Reset

Message Router Object (0x02)

This object has no supported attributes.

Assembly Object (0x04 - 3 Instances)

Class Attributes

Attribute ID	Name / Description	Data Type	Default Data Value	Access Rule
1	Revision	UINT	1	Get
2	Max Instance	UINT	81	Get

Instance 0x64 Attributes (Input Instance)

Attribute ID	Name / Description	Data Type	Default Data Value	Access Rule
3	Status Information:			Get
	Bitmap of Consume Instances with Data	DINT	0	
	Bitmap of Produce Instances with Data	DINT	0	

User Datagram Protocol (UDP) I/O Sequence Number Handshaking

The data producing device increments the data sequence number by one with the transmission of each new serial data packet. Valid sequence numbers are 1-65535. After the consuming device has processed the data, it must echo the sequence number in the handshake to allow the producing device to remove the data from the queue. This is required for I/O communications because UDP is not guaranteed to arrive in order.

If the Node ID number is passed as part of the I/O message, the message is stored to the appropriate location in the Modbus RTU table. Because communications are asynchronous, the Node ID number is also stored as part of the output data. It is the responsibility of the PLC programmer to make sure the proper request lines up with the proper response if the Cobalt is used as a request/response device.

Instance 0x65 Attributes (Input Instance 2)

Attribute ID	Name / Description	Data Type	Default Data Value	Access Rule
3	Serial Produce Data:			Get
	Consume Data Seq. Number Handshake	UINT	0	
	Produce Data Sequence Number	UINT	0	
	Node 1 Serial Produce Data Size	UINT	0	
	Node 1 Serial Produce Data	WORD[100]	All 0's	

Instance 0x66 Attributes (Input Instance 3)

Attribute ID	Name / Description	Data Type	Default Data Value	Access Rule
3	Serial Produce Data:			Get
	Consume Data Seq. Number Handshake	UINT	0	
	Produce Data Sequence Number	UINT	0	
	Node ID (1-32)	UINT	1	
	Node Serial Produce Data Size	UINT	0	
	Node Serial Produce Data	WORD[100]	All 0's	

Instance 0x70 Attributes (Output Instance 1)

Attribute ID	Name / Description	Data Type	Default Data Value	Access Rule
3	Serial Consume Data:			Get / Set
	Produce Data Seq. Number Handshake	UINT	0	
	Consume Data Sequence Number	UINT	0	
	Node 1 Serial Consume Data Size	UINT	0	
	Node 1 Serial Consume Data	WORD[100]	All 0's	

Instance 0x71 Attributes (Output Instance 2)

Attribute ID	Name / Description	Data Type	Default Data Value	Access Rule
3	Serial Consume Data:			Get / Set
	Produce Data Seq. Number Handshake	UINT	0	
	Consume Data Sequence Number	UINT	0	
	Node ID (1-32)	UINT	1	
	Node Serial Consume Data Size	UINT	0	
	Node Serial Consume Data	WORD[100]	All 0's	

Instance 0x80 Attributes (Configuration Instance)

Most I/O clients include a configuration path when opening an I/O connection to a server. There is no configuration data needed.

Instance 0x81 Attributes (Heartbeat Instance – Input Only)

This instance allows clients to monitor input data without providing output data.

Common Services

Service Code	Implementation		Service Name
	Class Level	Instance Level	
0x0E	Yes	Yes	Get Attribute Single
0x10	No	Yes	Set Attribute Single

Connection Manager Object (0x06)

This object has no attributes.

TCP Object (0xF5 - 1 Instance)

Class Attributes

Attribute ID	Name / Description	Data Type	Default Data Value	Access Rule
1	Revision	UINT	1	Get

Instance Attributes

Attribute ID	Name / Description	Data Type	Default Data Value	Access Rule
1	Status*	DWORD	1	Get
2	Configuration Capability*	DWORD	0	Get
3	Configuration Control*	DWORD	0	Get
4	Physical Link Object* Structure of: Path Size Path	UINT Array Of WORD	2 0x20F6 0x2401	Get
5	Interface Configuration* Structure of: IP Address Network Mask Gateway Address Name Server Name Server 2 Domain Name Size Domain Name	UDINT UDINT UDINT UDINT UDINT UINT STRING	0 0 0 0 0 0 0	Get
6	Host Name* Structure of: Host Name Size Host Name	UINT STRING	0 0	Get

*See section 5-3.2.2.1 – 5-3.2.2.6 of “Volume 2: EtherNet/IP Adaptation of CIP” from ODVA for more information regarding these attributes.

Common Services

Service Code	Implementation		Service Name
	Class Level	Instance Level	
0x0E	Yes	Yes	Get Attribute Single

Ethernet Link Object (0xF6 - 1 Instance)

Class Attributes

Attribute ID	Name / Description	Data Type	Default Data Value	Access Rule
1	Revision	UINT	1	Get

Instance Attributes

Attribute ID	Name / Description	Data Type	Default Data Value	Access Rule
1	Interface Speed*	UDINT	100	Get
2	Interface Flags*	DWORD	3	Get
3	Physical Address*	USINT Array[6]	0	Get

*See section 5-4.2.2.1 – 5-4.2.2.3 of “Volume 2: EtherNet/IP Adaptation of CIP” from ODVA for more details on this attribute.

Common Services

Service Code	Implementation		Service Name
	Class Level	Instance Level	
0x0E	Yes	Yes	Get Attribute Single

5.9.2 EtherNet/IP: Vendor Specific Objects

The Cobalt has two Vendor Specific Objects:

Vendor Specific Objects:

Cobalt Consume Data Object (0x64)

Cobalt Produce Data Object (0x65)

COBALT CONSUME DATA OBJECT (0X64 - 32 INSTANCES)

Class Attributes (Instance 0)

Attribute ID	Name / Description	Data Type	Default Data Value	Access Rule
1	Revision	UINT	1	Get
2	Maximum Consume Data Buffer Size (in words)	UINT	32768	Get
3	Bitmap of Consume Instances with Data Bit 0: Instance 1 ... Bit 31: Instance 32	DINT	0	Get

Instance Attributes (Instances 1-32)

Attribute ID	Name / Description	Data Type	Default Data Value	Access Rule
1	Consume Data Size (in words)	UINT	0	Get / Set
2	Consume Data [0-249]	UINT	0	Get / Set
3	Consume Data [250-499]	UINT	0	Get / Set
4	Consume Data [500-749]	UINT	0	Get / Set
5	Consume Data [750-999]	UINT	0	Get / Set
6	Consume Data [1,000-1,249]	UINT	0	Get / Set
...	...	...	...	...
10	Consume Data [2,000-2,249]	UINT	0	Get / Set
...	...	...	...	...
34	Consume Data [8,000-8,249]	UINT	0	Get / Set
...	...	...	...	...
38	Consume Data [9,000-9,249]	UINT	0	Get / Set
...	...	...	...	...
42	Consume Data [10,000-10,249]	UINT	0	Get / Set
...	...	...	...	...
82	Consume Data [20,000-20,249]	UINT	0	Get / Set
...	...	...	...	...
122	Consume Data [30,000-30,249]	UINT	0	Get / Set
...	...	...	...	...
126	Consume Data [31,000-31,249]	UINT	0	Get / Set
...	...	...	...	...
130	Consume Data [32,000-32,249]	UINT	0	Get / Set
131	Consume Data [32,250-32,249]	UINT	0	Get / Set
132	Consume Data [32,500-32,249]	UINT	0	Get / Set
133	Consume Data [32,750-32,767]	UINT	0	Get / Set

Common Services

Service Code	Implementation		Service Name
	Class Level	Instance Level	
0x05	No	Yes	Reset*
0x0E	Yes	Yes	Get Attribute Single
0x10	No	Yes	Set Attribute Single

*This Service Code is used to flush all attributes to zero.

Cobalt Produce Data Object (0x65 - 32 Instances)

Class Attributes (Instance 0)

Attribute ID	Name / Description	Data Type	Default Data Value	Access Rule
1	Revision	UINT	1	Get
2	Maximum Produce Data Buffer Size (in words)	UINT	32768	Get
3	Bitmap of Produce Instances with Data Bit 0: Instance 1 ... Bit 31: Instance 32	DINT	0	Get

Instance Attributes (Instances 1-32)

Attribute ID	Name / Description	Data Type	Default Data Value	Access Rule
1	Produce Data Size (in words)	UINT	0	Get / Set
2	Produce Data [0-249]	UINT	0	Get
3	Produce Data [250-499]	UINT	0	Get
4	Produce Data [500-749]	UINT	0	Get
5	Produce Data [750-999]	UINT	0	Get
6	Produce Data [1,000-1,249]	UINT	0	Get
...	...	...	...	...
10	Produce Data [2,000-2,249]	UINT	0	Get
...	...	...	...	...
34	Produce Data [8,000-8,249]	UINT	0	Get
...	...	...	...	...
38	Produce Data [9,000-9,249]	UINT	0	Get
...	...	...	...	...
42	Produce Data [10,000-10,249]	UINT	0	Get
...	...	...	...	...
82	Produce Data [20,000-20,249]	UINT	0	Get
...	...	...	...	...
122	Produce Data [30,000-30,249]	UINT	0	Get
...	...	...	...	...
126	Produce Data [31,000-31,249]	UINT	0	Get
...	...	...	...	...
130	Produce Data [32,000-32,249]	UINT	0	Get
131	Produce Data [32,250-32,249]	UINT	0	Get
132	Produce Data [32,500-32,249]	UINT	0	Get
133	Produce Data [32,750-32,767]	UINT	0	Get

Common Services

Service Code	Implementation		Service Name
	Class Level	Instance Level	
0x05	No	Yes	Reset*
0x0E	Yes	Yes	Get Attribute Single
0x10	No	Yes	Set Attribute Single

*This Service Code is used to flush all attributes to zero.

5.9.3 Application Object (0x67 _ 10 Instances)

Class Attributes (Instance 0)

Attribute ID	Name / Description	Data Type	Default Data Value	Access Rule
1	Revision	UINT	1	Get

Instance Attributes (Instances 1-32)

Attribute ID	Name / Description	Data Type	Default Data Value	Access Rule
1	Instance Type (0-3): 0 - Disable 1 – ControlLogix 2 – SLC 5/05 3 – PLC5E	USINT	0	Get
2	PLC IP Address	UDINT	0	Get
3	PLC Slot Location (0-255)	USINT	0	Get
11	Max Write Size in Words: 0 – Disabled 1 – 100 Words	UINT	0	Get
12	Write Tag Name (ControlLogix Only)	SHORT STRING	0	Get
13	Write File Number (SLC/PLC Only) NX:0 - where “X” is the File Number	UINT	7	Get
14	Write File Offset (SLC/PLC Only) N7:Y - where “Y” is the File Offset	UINT	0	Get
15	Write “Heartbeat” Timeout Measured in 10ms “ticks” 0 = disabled Max value: 6000 ticks	UINT	100	Get
21	Max Read Size in Words 0 – Disable Max Value: 100	UINT	0	Get
22	Read Tag Name (ControlLogix Only)	SHORT STRING	0	Get

Attribute ID	Name / Description	Data Type	Default Data Value	Access Rule
23	Read File Number (SLC/PLC Only) NX:0 - Where “X” is the File Number	UINT	7	Get
24	Read File Offset (SLC/PLC Only) N7:Y - Where “Y” is the File Offset	UINT	0	Get
25	Read Poll Rate Measured in 10ms “ticks” 0 = disabled 6000 ticks max	UINT	100	Get

Common Services

Service Code	Implementation		Service Name
	Class Level	Instance Level	
0x0E	Yes	Yes	Get Attribute Single

6 MODBUS TCP INTERFACE



For Cobalt HF-CNTL-IND-x2 models.

NOTE

One of the most popular and well-proven industrial automation protocols in use today is Modbus. Modbus is an open client/server application protocol. Modbus TCP allows the Modbus protocol to be carried over standard Ethernet networks. Modbus TCP is managed by the Modbus-IDA User Organization.

6.1 MODBUS TCP OVERVIEW

Under the Modbus TCP protocol, the Cobalt acts as a Modbus Server and the PLC acts as a Modbus Client. By utilizing Produce and Consume registers for mapping commands and responses, data produced by the Cobalt is consumed by the Modbus Client and data produced by the Modbus Client is consumed by the Cobalt.

- Modbus Client (Host or PLC) must connect to the Modbus Server (Cobalt) on port 502
- Maximum number of words transferred to/from an RFID tag per read/write cycle: 100 Words / 200 Bytes
- Disable any firewall services running on the PC. Firewalls can potentially block communications between the Cobalt and the host and/or PLC

6.2 MODBUS TCP CONFIGURATION VIA HTTP SERVER

To configure the Cobalt for Modbus TCP communications, begin by assigning the controller a locally compatible IP address.

Through a standard Web browser, you can utilize the Cobalt's *HTTP Server* to access an embedded suite of controller configuration tools, called the "**OnDemand Utilities**." Among its features is the ability to modify and save changes to the controller's IP address, which is stored internally on the Cobalt.

Cobalt Industrial Ethernet RFID Controller - Default IP Address:
192.168.253.110

Setting the Cobalt IP Address

To set the Cobalt's IP address using the *HTTP Server*, follow the steps below:

1. Open a Web browser on the host.
2. In the URL address field, enter the Cobalt's IP address (192.168.253.110 = *factory default*).
3. Press **ENTER**.

The *HTTP Server - Main Page* will be displayed.

HTTP Server – Main Page

DATALOGIC™

HF-CNTL-IND v1.0.A
Industrial Ethernet RFID Control

[OnDemand Config](#)

[OnDemand Status](#)

[Serial Config](#)

[EMS Web Page](#)

Description
Station 1
Edit

Network Settings
IP Address: 192.168.253.110
Subnet Mask: 255.255.255.0
Gateway IP Address: 0.0.0.0
Edit

Network Status
MAC Address: 00:40:9D:26:D9:70
Revision: 1.27
Link Duplex: FULL
Link Speed: 100 MBPS

Figure 53 - The HTTP Server - Main Page

The **HTTP Server - Main Page** lists the network settings (including the IP address) currently stored on the Cobalt.

- Click the button labeled ***EDIT***, located below ***Network Settings.***

Network Settings

IP Address: 192.168.253.110

Subnet Mask: 255.255.255.0

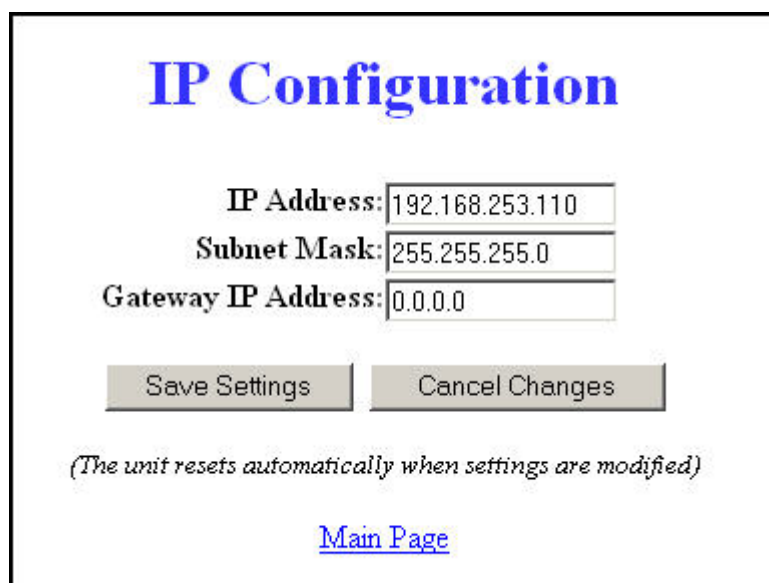
Gateway IP Address: 0.0.0.0

[Edit](#)

The IP Configuration Page will be displayed.

IP Configuration Page

The *IP Configuration Page* is used to modify and save changes to the IP Address, Subnet Mask and (Network) Gateway IP Address.



IP Configuration

IP Address: 192.168.253.110

Subnet Mask: 255.255.255.0

Gateway IP Address: 0.0.0.0

Save Settings Cancel Changes

(The unit resets automatically when settings are modified)

[Main Page](#)

Figure 54 - The IP Configuration Page

5. In the fields provided, enter your new IP configuration values for the Cobalt.
6. Click the “**Save Settings**” button to store your new IP configuration, then cycle power to the controller to store the changes in the main memory. The Ethernet module will reset and your IP changes will be implemented.
7. After the Cobalt has restarted, verify the new IP configuration by opening a Web browser and manually entering the Cobalt’s new IP address in the URL field. If successful, you should arrive back at the *HTTP Server – Main Page*.

6.2.1 Modbus TCP - Command Packet Structure

Consume Registers hold data that is destined for the Cobalt. Modbus TCP commands must be placed in the holding registers, starting at address 40001, of Device ID 01 (Node Input Page 01). Commands utilize at least six registers (double-byte values or words).

Modbus Address (4xxxx / 3xxxx)	Read / Write Privilege	Register Description
(40001) 1	R/W	2-byte Consume Data Overall Length (> 0 indicates data is available; Cobalt clears to 0 after data is processed)
2	R/W	MSB = Reader Type LSB = Command ID
3	R/W	MSB = 0x00 LSB = Node ID (0x01 for the Cobalt)
4	R/W	2-byte Timeout Value (0-65535) measured in milliseconds
5	R/W	2-byte Start Address (0-65535)
6	R/W	2-byte Read/Block Size (0-65535 bytes)
7 – 32774	R/W	Cobalt Consume Data (when applicable)
32775 – 65536	R/W	Reserved

6.2.2 Modbus TCP - Response Packet Structure

Produce Registers hold data that is destined for the host or PLC.

Modbus Address (4xxxx / 3xxxx)	Read / Write Privilege	Register Description
(40001) 1	R/W	2-byte Produce Data Overall Length (> 0 indicates data is available; Modbus Client clears to 0 after data is processed)
2	RO	MSB = Reader Type LSB = Command Echo
3	RO	Node ID Number (33 for the Cobalt)
4	RO	Timeout Value (0-65535)
5	RO	Read/Write Start Address (0-65535)
6	RO	Read/Block Size (0-65535 bytes)
7 – 32774	RO	Cobalt Produce Data (when applicable)
32775 – 65536	RO	Reserved

6.2.3 Modbus TCP - Mapping for Node 33

Modbus Address (4xxxx)	Read / Write Privilege	Register Description
1	R/W	IP Address 1 (MSB) Example: 192
2	R/W	IP Address 2 Example: 168
3	R/W	IP Address 3 Example: 000
4	R/W	IP Address 4 (LSB) Example: 100
5	R/W	Subnet Mask 1 (MSB) Example: 255
6	R/W	Subnet Mask 2 Example: 255
7	R/W	Subnet Mask 3 Example: 255
8	R/W	Subnet Mask 4 (LSB) Example: 000
9	R/W	Gateway Address 1 (MSB) Example: 192
10	R/W	Gateway Address 2 Example: 168
11	R/W	Gateway Address 3 Example: 000
12	R/W	Gateway Address 4 (LSB) Example: 001
13	RO	MAC Address 1 (MSB) Example: 0x00
14	RO	MAC Address 2 Example: 0x40
15	RO	MAC Address 3 Example: 0x9D
16	RO	MAC Address 4 Example: 0x12
17	RO	MAC Address 5 Example: 0x34
18	RO	MAC Address 6 (LSB) Example: 0x56
19	RO	Link Status: 0 = No Link 1 = Link is OK
20	RO	Ethernet Speed (10M or 100M bits)
21	RO	Link Duplex: 0 = Half Duplex 1 = Full Duplex
22	RO	Revision (Major/Minor)
23 – 1000	R/W	Reserved
1001	RO	(Input) Data Ready Mask - Nodes 1 - 16
1002	RO	(Input) Data Ready Mask - Nodes 17 - 32
1003	RO	(Output) Data Ready Mask - Nodes 33 - 48
1004	RO	(Output) Data Ready Mask - Nodes 49 - 64
1005-10099	R/W	Reserved
10100 – 10199	R/W	Reserved
10200 – 10299	R/W	Reserved
...	...	...
13100 – 13199	R/W	Reserved
13200 – 13299	R/W	Reserved
13300 – 65536	R/W	Reserved

6.3 MODBUS TCP - HANDSHAKING

Due to the process with which commands and responses are passed between the Cobalt and the host, a handshaking procedure is used to notify the host that returning data is available for retrieval.

Overall Length

The handshaking process is governed by the changing of the “**Overall Length**” value within a data packet. The Overall Length value is typically the first word (2-bytes) of a command or response and indicates the total number of data words in the packet.

Node Input and Node Output Pages

Under the Modbus TCP protocol, host-generated data is written to a pre-defined region of the Cobalt’s own memory known as the **Node Input Page**. Host-bound data generated by the Cobalt, is written to a separate region of the Cobalt’s memory known as the **Node Output Page** (in Modbus TCP these regions of memory are called **Device IDs**). Node Input and Node Output Pages are used to temporarily hold incoming (controller-bound) and outgoing (host-bound) data.

Output Data Ready Mask

To notify the host that new data is waiting to be retrieved from the Node Output Page, the Cobalt utilizes a separate 32-bit block of internal memory, called the **Output Data Ready Mask**.

The first bit of the 32-bit Output Data Ready Mask represents the status of the Node Output Page. For example, the first or lowest bit (*bit 01*) represents Node Output Page 33 - which holds output data from Node 01.

The Cobalt, itself, is assigned Node 01 and thus, its corresponding Node Output Page is 33. As noted, Node Output Page 33 is represented by the first bit (*bit 01*) in the Output Data Ready Mask.

Holding Registers

When writing host-bound data to Node Output Page 33, the Cobalt actually places each byte of the data packet into pre-defined “**holding registers**” within the Node Output Page. Note that a single holding register stores 2-bytes or one word of data. The 2-byte **Overall Length** value, for example, is written to the first holding register (which is location **40001**) of the Node Output Page.

Then, as the Cobalt finishes writing host-bound data to the Node Output Page, the Overall Length value (stored at holding register 40001) will change from its default value of **0x00** to reflect the number of data words within the newly written host-bound data packet. This change to the Overall Length value (i.e. register 40001) within the Node Output Page, triggers the Cobalt to enable (change from zero to one) bit one in the Output Data Ready Mask. It is when bit one in the Output Data Ready Mask has become enabled, that the host will recognize the pending data.

Finally, after the host has retrieved its pending data, the enabled bit in the Output Data Ready Mask and the Overall Length value at holding register 40001 of the Node Output

Page will be reset to zero (0x00), indicating that the host has received and processed its pending data.

6.3.1 Modbus TCP - Host/Cobalt Handshaking

When the host issues a command, it must first write the entire command to the Node Input Page, leaving the Overall Length value to be written last.

For example, for the host to issue the 6-word command “*Read Data*,” it must first write the last five words of the command to Node Input Page 01, beginning at register 40002. After which, the host will fill in the first word (at holding register 40001) with the Overall Length of the command packet.

Last Five Words of a Read Data Command

Word	MSB	LSB	Description
02	0xAA	0x05	Command ID: Read Data
03	0x00	0x01	Node ID: 0x01
04	0x03	0xE8	Timeout Value: 1 second
05	0x00	0x20	Read Start Address: 0x0020
06	0x00	0x04	Block Size: 4 Bytes

After writing the last five words of the command, the host will write the Overall Length value to holding register 40001 of Node Input Page 01.

First Word of a Read Data Command

Word	MSB	LSB	Description
01	0x00	0x06	Overall Length (<i>in words</i>)

The moment the Overall Length value (at holding register 40001) of Node Input Page 01 changes from 0x0000 to a “non-zero” value, the Cobalt will recognize the waiting data and will execute the command.

6.3.2 Modbus TCP - Handshaking Example

1. The host or PLC issues an RFID command to the Cobalt, writing the command string to the holding registers for Device ID 01 (Node Input Page 01). An Overall Length value of 0x0006 is written last to holding register 40001.
2. The Cobalt recognizes that the Overall Length value at holding register 40001 has changed for Device ID 01 (Node Input Page 01), indicating that a command is waiting to be executed.
3. The Cobalt executes the command and then clears the Overall Length holding register of Device ID 01 (Node Input Page 01), setting it back the default value of zero (0x0000).

**NOTE**

NOTE: when the Node Input Page's value at register 40001 is returned to 0x0000, the host can assume that the command was at least received and execution was attempted. The host can also assume that it is OK to clear the remaining holding registers and write another command to the Device ID (Node Input Page).

4. After the Cobalt executes its given command instructions, it will write the command response to the holding registers for Device ID 33 (Node Output Page 33). Again, the Overall Length value is written last to holding register 40001.

**NOTE**

Host-bound data is always written to Device ID 33 (Node Output Page 33).

5. With holding register 40001 of Device ID 33 (Node Output Page 33) now containing a non-zero length value, the Cobalt will enable (change from zero to 1) the first bit in the *Output Data Ready Mask*. (The first bit is allocated to Node Output Page 33).
6. Once bit 01 in the *Output Data Ready Mask* becomes enabled, the host retrieves the data string stored in the holding register area for Device ID 33 (Node Output Page 33).
7. After importing the data from Device ID 33 (Node Output Page 33), the host clears (sets back to 0x0000) the Overall Length value at holding register 40001 of Device ID 33 (Node Output Page 33). In doing so, bit 01 in the *Output Data Ready Mask* is also cleared.

**NOTE**

The clearing of bit 01 in the Output Data Ready Mask indicates to the Cobalt that the host has received the response and that it is now OK to write another response to Node Output Page 33.

This completes the Modbus TCP handshaking cycle.

7 STANDARD TCP/IP INTERFACE



For Cobalt HF-CNTL-IND-x2 models.

NOTE

7.1 STANDARD TCP/IP OVERVIEW

Another means of communicating with the Cobalt is through the standard TCP/IP protocol. For this manual, the protocol is referred to as **Standard TCP/IP** to distinguish it from other industrial protocols.

In this environment, the Cobalt acts as the server and the host or PLC acts as client. Standard TCP/IP sessions are established between the host computer and the Cobalt via TCP/IP client software. A TCP/IP session generally consists of three stages: *connection setup*, *data transactions* and *connection termination*.

All connections to the Cobalt are initiated by client side software only. If, for example, an existing connection terminates unexpectedly, the Cobalt will not attempt to contact the client software or re-establish a connection. The client is responsible for opening, maintaining, and closing all TCP/IP sessions.

After establishing a successful connection, communications between the host and the Cobalt can proceed. When communication is no longer necessary, it is the responsibility of the client side application to terminate the connection.

- The TCP/IP client software (running on the host or PLC) must connect to the TCP/IP server (Cobalt) on port 2101
- Maximum number of words transferred to/from an RFID tag per read/write cycle: 100 Words / 200 Bytes
- Disable any firewall services running on the PC. Firewalls can potentially block communications between the Cobalt and the host and/or PLC

7.2 STANDARD TCP/IP - IP CONFIGURATION VIA HTTP SERVER

To configure the Cobalt for standard TCP/IP communications, begin by assigning the controller a locally compatible IP address.

Through a standard Web browser, you can utilize the Cobalt's *HTTP Server* to access an embedded suite of controller configuration tools, called the "**OnDemand Utilities**." Among its features is the ability to modify and save changes to the controller's IP address, which is stored internally on the Cobalt.

Cobalt Industrial Ethernet RFID Controller Default IP Address:
192.168.253.110

Setting the Cobalt IP Address

To set the Cobalt's IP address using the *HTTP Server*, follow the steps below:

1. Open a Web browser on the PC.
2. In the URL address field, enter the Cobalt's IP address (*192.168.253.110 = factory default*).
3. Press ENTER.

The HTTP Server - Main Page will be displayed.

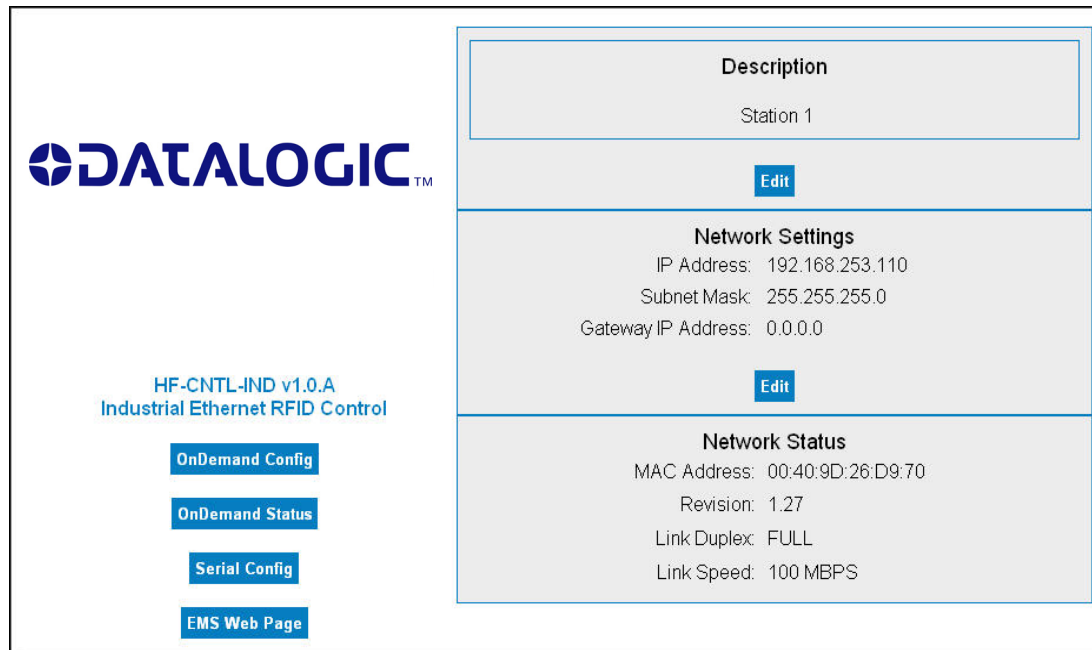
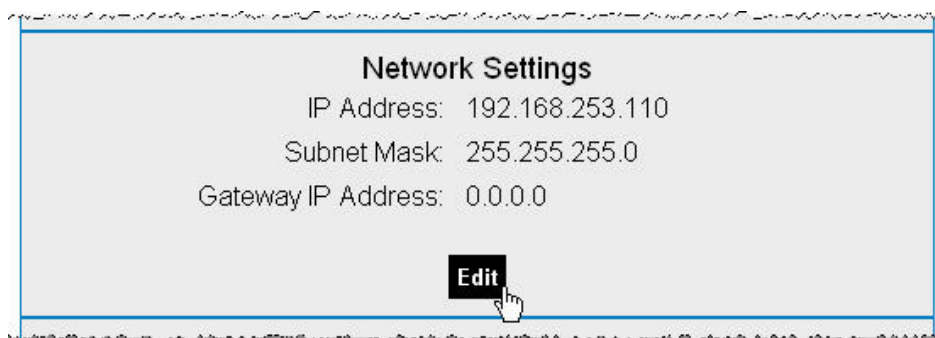


Figure 55 - The HTTP Server - Main Page

The HTTP Server - Main Page lists the network settings (including the IP address) currently stored on the Cobalt.

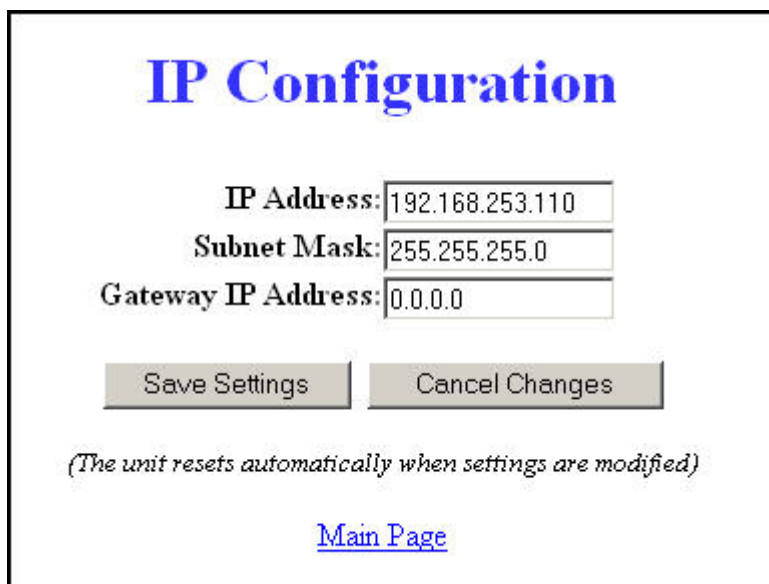
4. Click the button labeled "EDIT", located below "Network Settings."



The IP Configuration Page will be displayed.

IP Configuration Page

The *IP Configuration Page* is used to modify and save changes to the IP Address, Subnet Mask and (Network) Gateway IP Address.



IP Configuration

IP Address: 192.168.253.110

Subnet Mask: 255.255.255.0

Gateway IP Address: 0.0.0.0

Save Settings Cancel Changes

(The unit resets automatically when settings are modified)

[Main Page](#)

Figure 56 - The IP Configuration Page

5. In the fields provided, enter your new IP configuration values for the Cobalt.
6. Click the “**Save Settings**” button to store your new IP configuration. The Cobalt will completely reset and your IP changes will be implemented.
7. After the Cobalt has restarted, verify the new IP configuration by opening a Web browser and manually entering the Cobalt’s new IP address in the URL field. If successful, you should arrive back at the *HTTP Server – Main Page*.

7.3 STANDARD TCP/IP - COMMAND & RESPONSE EXAMPLES

In standard TCP/IP, RFID commands issued by the host resemble Modbus TCP commands. The Cobalt handles all handshaking tasks.

Moreover, the command & response packets need an additional word at the beginning of the string:

Protocol Header 0xFF in MSB, **<Node ID>** in LSB.

Please notice that these two bytes are not considered part of the CBx command packet and should not be counted in the Overall Length.

Below is the structure of the additional word required, named as **Word # 00**:

Word #	Command Packet Element	MSB	LSB
00	Protocol Header in MSB: 0xFF Node ID in LSB	0xFF	<Node ID>

And similarly for the response:

Word #	Response PACKET ELEMENT	MSB	LSB
00	Protocol Header in MSB: 0xFF Node ID Echo in LSB	0xFF	<Node ID Echo>



NOTE

These first two bytes will not be returned in the response packet for commands executed by Node 01.

Therefore, the command packet structure for Standard TCP/IP applications is:

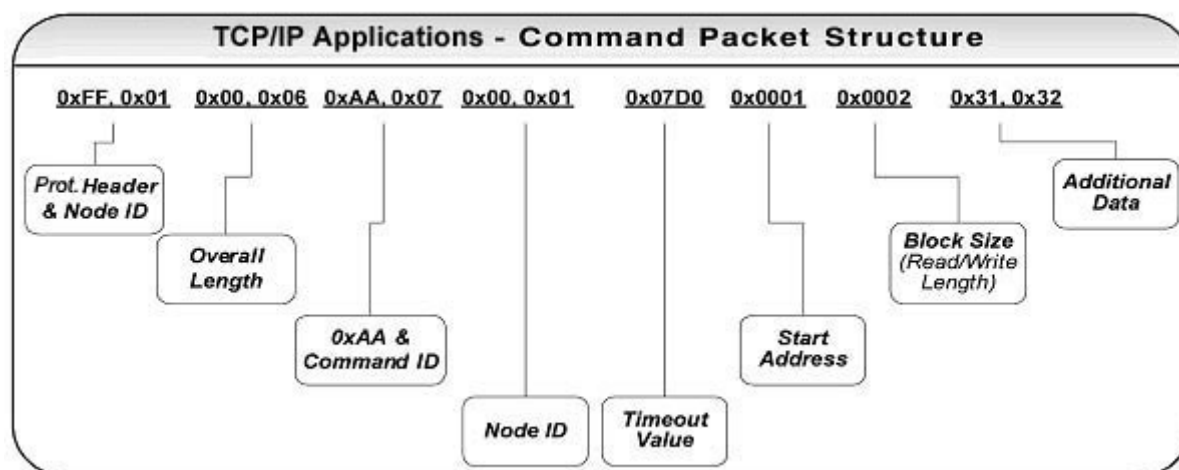


Figure 57 - Standard TCP/IP Protocol Command Packet Structure

7.3.1 Standard TCP/IP - Command Structure Example

In the following example, a 12-byte command has been issued to the Cobalt, instructing the controller to read six bytes from a tag within RF range. A *Timeout Value* of five seconds has been set for the completion of the command.

Word	Description	MSB	LSB
00	Protocol Header in MSB = 0xFF Node ID in LSB = default value for Cobalt -IND is one (0x01)	0xFF	0x01
01	Overall Length: 2-byte integer indicating number of "words" in the command packet	0x00	0x06
02	MSB = 0xAA LSB = Command ID: (example: 0x05 – Read Data)	0xAA	0x05
03	MSB = 0x00 LSB = Node ID: default value for Cobalt -IND is one (0x01)	0x00	0x01
04	Timeout Value: 2-byte integer measured in .10 (1/10 th) second increments. (0x0032 = 50 x .10 or 5 seconds)	0x00	0x32
05	Start Address: 2-byte integer identifies tag address where read will begin	0x00	0x01
06	Block Size: 2-byte integer indicates number of bytes to retrieve	0x00	0x06

7.3.2 Standard TCP/IP - Response Structure Example

The following resembles a typical response to the command issued in the previous example:

Word	Description	MSB	LSB
00	Protocol Header in MSB = 0xFF Node ID in LSB = default value for Cobalt -IND is one (0x01)	0xFF	0x01
01	Overall Length: 2-byte integer indicating number of "words" in the response packet	0x00	0x09
02	MSB = 0xAA LSB = Command Echo: (0x05 - Read Data)	0xAA	0x05
03	MSB = Instance Counter LSB = Node ID: 0x01	<IC>	0x01
04	Time Stamp: Month / Day (March 19 th)	0x03	0x13
05	Time Stamp: Hour / Minute (8:15 a.m.)	0x08	0x0E
06	MSB = Time Stamp: Seconds LSB = Number of Additional Bytes Retrieved: 6	0x00	0x06
07	Retrieved Bytes 1 & 2	0x61	0x62
08	Retrieved Bytes 3 & 4	0x63	0x64
09	Retrieved Bytes 5 & 6	0x65	0x66

8 DEVICENET INTERFACE



For Cobalt HF-CNTL-DNT-02 models.

NOTE

8.1 DEVICENET OVERVIEW

DeviceNet is a digital, multi-drop network based on the CAN (Controller Area Network) specification, which permits easy connectivity between industrial controllers and I/O devices.

When the Controller is connected to a DeviceNet network, it is considered an individual node for which a unique Node Address number between 1 and 63 is assigned. The DeviceNet Controller conforms to the standards set by the Open DeviceNet Vendor Association (ODVA).

8.2 DEVICENET CONFIGURATION

8.2.1 Importing the Controller.EDS File

After making all necessary hardware connections, the next step in configuring the HF-CNTL-DNT-02 for DeviceNet is to import the .EDS file.



NOTE

Electronic Data Sheets (.EDS) are basic text files that are utilized by network configuration tools to identify and configure hardware devices for DeviceNet networks. A typical .EDS file contains a description of the product, its device type, hardware version and configurable parameters.*

*The .EDS file (filename: "**DeviceNet EDS.zip**") for the HF-CNTL-DNT-02 is available from the technical support area of the Datalogic Automation website.*

1. Download the .EDS file to the computer running your network's Rockwell Automation software (i.e. the host computer).
2. Using the *EDS Hardware Installation Tool*, located in the *RSLinx™ Tools* program group, import the .EDS file into your RSNetWorx/DeviceNet system. Refer to Rockwell Automation's documentation for specific instructions.
3. After you have imported the .EDS file, close and restart all Rockwell Automation programs. If you are uncertain which programs to close, cycle power to the host computer after importing the .EDS file.

8.2.2 Configuring Controller and PLC DeviceNet Communications

After importing the .EDS file and rebooting the host computer (or after restarting your Rockwell Automation software), follow the steps below to continue configuring DeviceNet network communications between the Controller and a *ControlLogix* PLC.

1. On the host computer, start RSNetWorx for DeviceNet.
2. Go online (click NETWORK and select ONLINE).

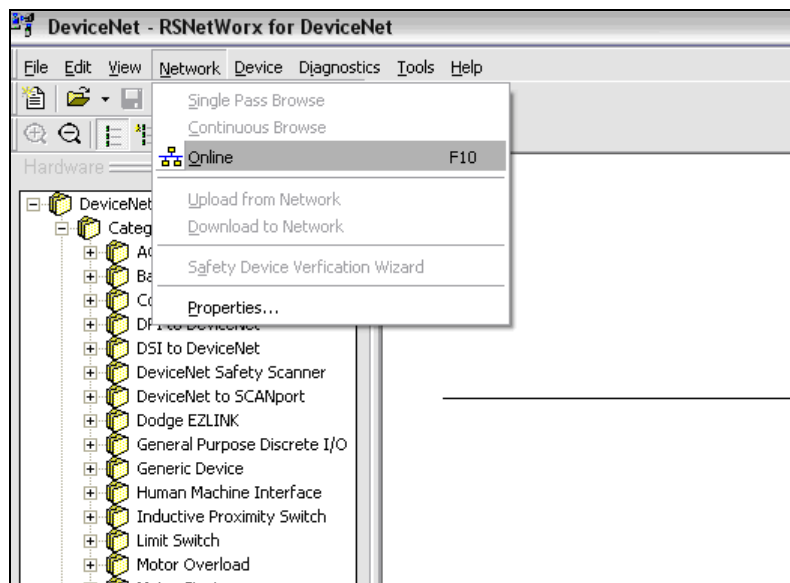
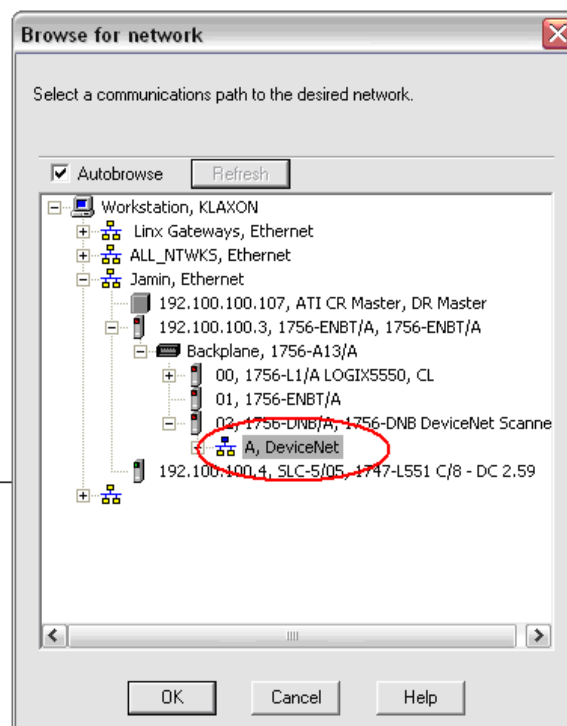


Figure 58 - Configuring Controller for DeviceNet - Going Online



3. Select the appropriate DeviceNet network and then click “OK.”

The *Scanner Configuration Applet* in *RSNetWorx* will begin scanning the specified network. This procedure may take some time depending on the speed of the bus and the number of devices connected. Node addresses are scanned from zero to 63. The default node address for the Controller is 63.

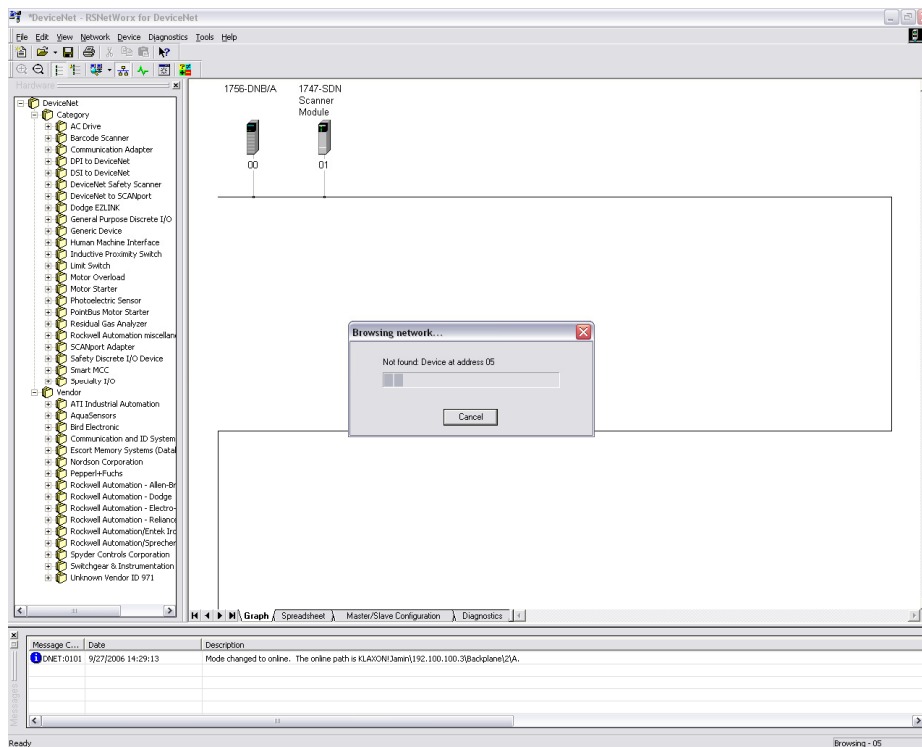


Figure 59 - Scanning Node Addresses on a DeviceNet Network

4. When the scan operation has completed, click **“UPLOAD”**, in the *Scanner Configuration Applet* dialog box, to update the configuration of the *RSNetWorx* software.

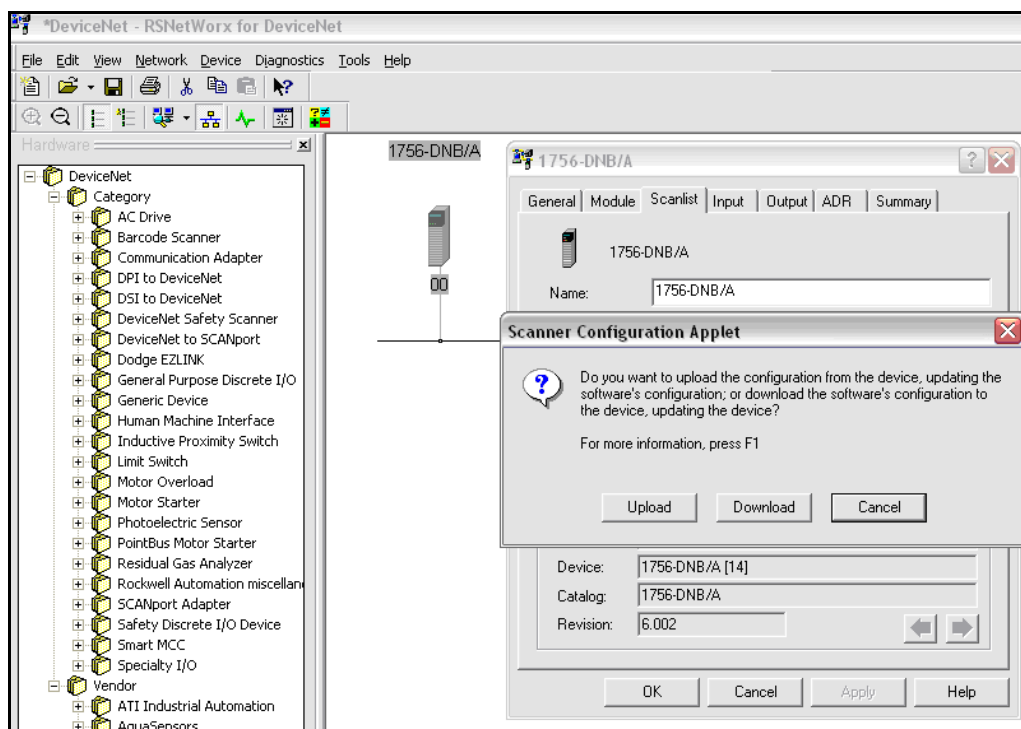
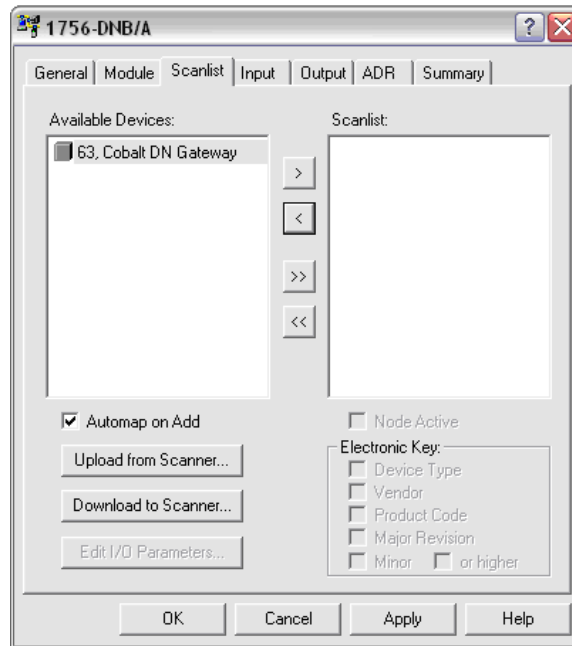


Figure 60 - Updating Configuration in RSNetWorx

**NOTE**

The 1756-DNB/A is a Series A DeviceNet Bridge / Scanner Module. After updating the software, the Controller should be recognized on the network and the device name, “63, Cobalt DN Controller”, should be displayed under “Available Devices.”

4. Highlight the *Controller* in the *Available Devices* list, and add it to the *Scanlist* field on the right hand side of the dialogue box. Click “**Apply**” and then “**OK**.”

The Controller will be added to the list of DeviceNet hardware in RSNetWorx.

5. Next, select the *Controller* from the list of DeviceNet hardware and edit its *I/O Parameters*. Set the *Input Size* and *Output Size* parameters according to your application requirements, then click “**OK**.” In the example below, 30 input bytes and 30 output bytes will be scanned per polling cycle.

**NOTE**

Strobed mode is not supported by the HF-CNTL-DNT-02.

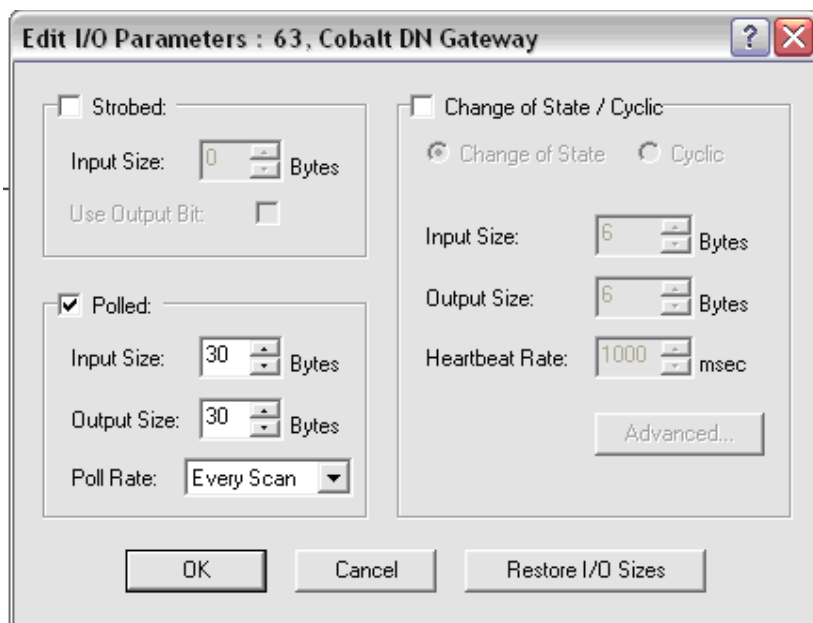


Figure 61 - Editing the Controller's DeviceNet I/O Parameters

The following images display the **Input** and **Output** properties tabs (in *RSNetWorx for DeviceNet*) for the *1756-DNB/A DeviceNet Bridge / Scanner Module* after running the *Scanner Configuration Applet* for a second time. The scanner module, in this case, only identified one node, the Controller, at node address 63. The tabs are used to identify where input and output data is mapped for each identified node. In the image below, input data is mapped to start at **1:I.Data(0).0** on the PLC.

6. Run the *Scanner Configuration Applet* and verify the mapping of the address where the PLC will write input data for the Controller.

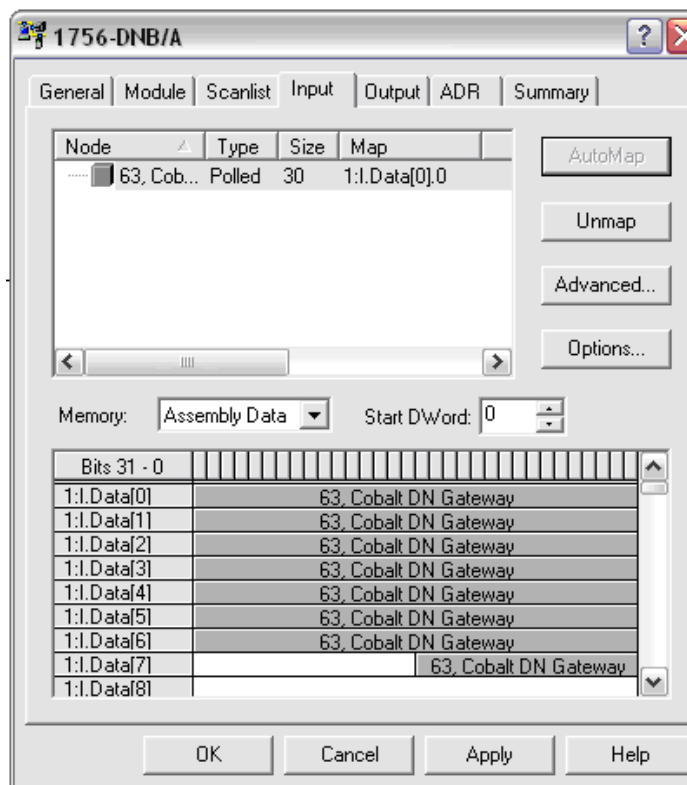


Figure 62 - 1756-DNB/A Input Properties Tab

7. Next, verify the mapping of the address where the PLC will retrieve output data from the Controller. In the image below, output data is mapped to start at **1:O.Data(0).0** on the PLC.

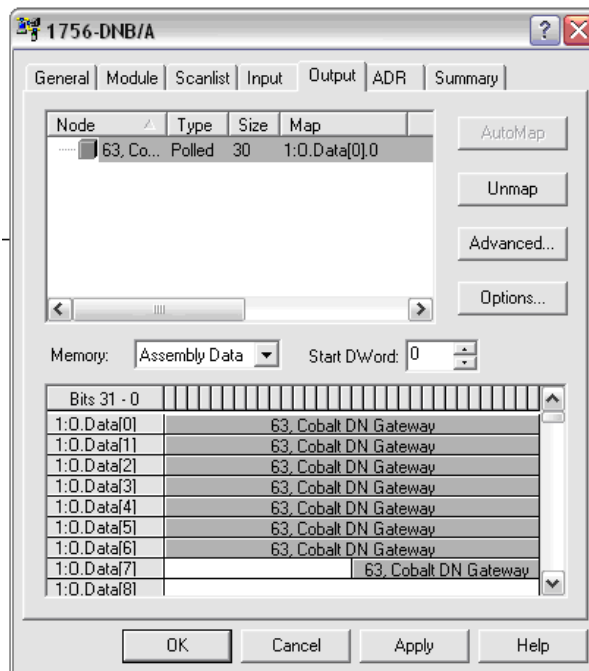


Figure 63 - 1756-DNB/A Output Properties Tab

8. Lastly, click **“Apply”** and select **“YES”** to download the configuration and mapping settings from RSNetWorx to the PLC.

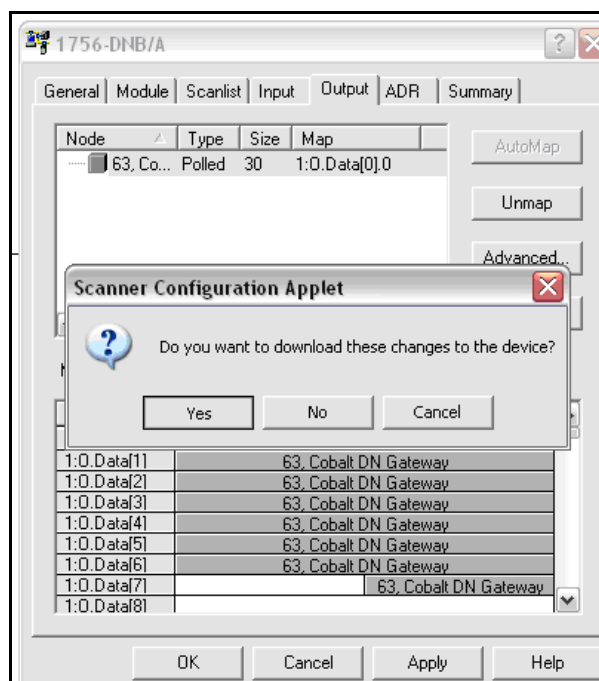


Figure 64 - 1756-DNB/A Output Properties Tab

8.2.3 Configuring Data Rate and Node Address

As noted, each device, computer and controller on a DeviceNet network is considered an individual node for which a unique *Node Address* number (between 0 and 63) is assigned. The node address provides a means of numerically identifying each device on a DeviceNet network.

Prior to operating the HF-CNTL-DNT-02, you must verify that it has been configured for the same Data Rate as your network and that it has been assigned a suitable node address value. The Controller supports data rates of 125Kb (default), 250Kb and 500Kb and supports node addresses 1 – 63 (default: 63).

To change the data rate or node address, use either the "*Node Commissioning*" tool in *RSNetWorx for DeviceNet* or the Datalogic "Cobalt Dashboard™" utility running on a host computer that is connected to the RS232 port on the Controller. The *Cobalt Dashboard™* utility is available on the Datalogic Web site (www.automation.datalogic.com).

**NOTE**

When using node commissioning in RSNetWorx for DeviceNet, modify only one parameter at a time (either data rate or node address). After changing the data rate, you must manually cycle power to your DeviceNet network for the change to take effect.

Factory Default Configuration:

Data Rate = 125Kb

Node Address = 63

8.2.4 DeviceNet - Exchanging Data and Handshaking

After the Controller has been properly configured for your DeviceNet network, it will be possible to send the Controller commands using the Datalogic **CBx Command Protocol**. For reference, the CBx Command Protocol Reference Manual is available on the Datalogic Web site (www.automation.datalogic.com).

However, to ensure that messages to and from the Controller are properly delivered and received, a handshaking mechanism has been implemented that uses a pair of dedicated words in the exchange.

The first two words in the *Input Controller Tag* and *Output Controller Tag* are dedicated to handshaking. When new information is generated, the data-producing device increments the counter value stored in the second word of a controller tag (either Input or Output, depending on the device). The data-consuming device, copies that same value to the counter in the first word of the reciprocal (or opposite) controller tag. This handshaking scheme signals to the data producer that the information has been received.

The image below displays an example of the data contained in the two I/O Controller Tags for the Controller.

The screenshot displays the RSLogix 5000 interface with the 'Controller Tags' window open. The left pane shows the project tree with 'Controller CL' expanded. The main pane shows two tables of controller tags. The first table, 'Controller Tags - CL(controller)', lists tags for Local:2:I (Input) and Local:2:O (Output). The second table, 'Controller Tags - CL(controller)', lists tags for Local:2:O (Output) and Local:2:I (Input). Red circles highlight the handshake values in the first and second words of the data tags.

Tag Name	Value	Force Mask	Style	Type	Descrip
Local:2:I	{...}	{...}		AB:1756_DNB_5...	
Local:2:I.StatusRegister	{...}	{...}		AB:1756_DNB_St...	
Local:2:I.Data	{...}	{...}	Hex	DINT[124]	
Local:2:I.Data[0]	16#00df_0050		Hex	DINT	
Local:2:I.Data[1]	16#ffff_0007		Hex	DINT	
Local:2:I.Data[2]	16#002d_0e01		Hex	DINT	
Local:2:I.Data[3]	16#1c01_0001		Hex	DINT	
Local:2:I.Data[4]	16#6720_0700		Hex	DINT	
Local:2:I.Data[5]	16#0000_0000		Hex	DINT	
Local:2:I.Data[6]	16#0000_0000		Hex	DINT	

Tag Name	Value	Force Mask	Style	Type	Descrip
Local:2:O	{...}	{...}		AB:1756_DNB_5...	
Local:2:O	{...}	{...}		AB:1756_DNB_4...	
Local:2:O.CommandRegister	{...}	{...}		AB:1756_DNB_C...	
Local:2:O.Data	{...}	{...}	Hex	DINT[123]	
Local:2:O.Data[0]	16#0050_00de		Hex	DINT	
Local:2:O.Data[1]	16#aa05_0006		Hex	DINT	
Local:2:O.Data[2]	16#0352_0001		Hex	DINT	
Local:2:O.Data[3]	16#000a_0000		Hex	DINT	
Local:2:O.Data[4]	16#0000_0000		Hex	DINT	
Local:2:O.Data[5]	16#0000_0000		Hex	DINT	
Local:2:O.Data[6]	16#0000_0000		Hex	DINT	
Local:2:O.Data[7]	16#0000_0000		Hex	DINT	

Figure 65 - Controller I/O Controller Tags (in RSLogix 5000)

8.2.5 DeviceNet - Handshaking Example

This example describes the sequence of events for a simple command and response. All data is written in 2-byte *WORD* format and stored in 2-byte “*registers*.”

The **Output Controller Tag** holds command data written by the PLC. The **Input Controller Tag** holds response data generated by the Controller. Handshaking is implemented using the first two words (*Words 0 and 1*) in both *Input Controller Tag* and *Output Controller Tags*.

The PLC writes a command to the *Output Controller Tag*, starting with the 2-byte *Consume Data Size* value at **Local:2:O.Data [2]** (which is the third register of the *Output Controller Tag*). The remainder of the command packet is then written, 2-byte per register, to the *Output Controller Tag*, starting at the fourth register, **Local:2:O.Data [3]**. After writing the command packet data to the appropriate registers, the PLC increments the counter value stored at **Local:2:O.Data [1]** (the second register in the *Output Controller Tag*).

The counter at **Local:2:O.Data [1]** is copied by the Controller to **Local:2:I.Data [0]** (the first register of the *Input Controller Tag*) which signals the PLC that the command has been received by the Controller.

Following execution of the command, the Controller writes its response to the *Input Controller Tag*, starting with the 2-byte *Produce Data Size*, at **Local:2:I.Data [2]** and the actual data beginning at **Local:2:I.Data [3]**. It then increments the counter value at **Local:2:I.Data [1]**. This alerts the PLC to the new data available (the Controller generated response, in this case).

After processing the response information, the PLC copies the counter from **Local:2:I.Data [1]** to **Local:2:O.Data [0]**, which signals to the Controller that the PLC has retrieved the response data.

OUTPUT CONTROLLER TAG

Controller Tag Location and Data	Description
Local:2:O.Data [0]	(4) The PLC copies the value at 2:I.Data[1] here to acknowledge receipt of the response
Local:2:O.Data [1]	(1) The PLC increments this counter value after copying a command in Consume Data
Local:2:O.Data [2]	Consume Data Size
Local:2:O.Data [3]	First WORD of Consume Data (<i>Command from PLC</i>)
Local:2:O.Data [xxx]	xxx WORD of Consume Data

INPUT CONTROLLER TAG

Controller Tag Location and Data	Description
Local:2:I.Data [0]	(2) The value at 2:O.Data[1] is copied here by the Controller to acknowledge receipt of a command
Local:2:I.Data [1]	(3) The Controller increments this counter to signal that a response is available
Local:2:I.Data [2]	Produce Data Size
Local:2:I.Data [3]	First WORD of Produce Data (<i>Response from Controller</i>)
Local:2:I.Data [xxx]	xxx WORD of Produce Data

NOTE: A ladder logic example illustrating the implementation of this handshaking strategy can be downloaded from the technical support area of the Datalogic Automation website.

9 PROFIBUS INTERFACE



For Cobalt HF-CNTL-PBS-02 models.

NOTE

9.1 PROFIBUS OVERVIEW

Profibus was created under German Government leadership in co-operation with automation manufacturers (Siemens) in 1989. Today it is commonly found in Process Control, large assembly and material handling machines. Just a single-cable which is able to wire multi-input sensor blocks, pneumatic valves, complex intelligent devices, smaller sub-networks, operator interfaces and many other devices.

9.2 PROFIBUS-DP

Basically Profibus is available in three different versions:

Profibus-DP (Decentralized Periphery)

Multiple masters are possible with Profibus-DP, in which case each slave device is assigned to one master. This means that multiple masters can read inputs from the device but only one master can write outputs to that device.

Profibus-FMS

It is a peer to peer messaging format, which allows masters to communicate with one another. Just as in Profibus-DP, up to 126 nodes are available and all can be masters if desired. FMS messages consume more overhead than DP messages.

Profibus-PA

PA protocol is the same as the latest Profibus-DP except that voltage and current levels are reduced to meet the requirements of intrinsic safety (Class I div. II) for the process industry.

The Profibus Controller supports **Profibus-DP only**, since this version has been specifically designed for factory automation.

MAIN FEATURES:

Maximum Number of Nodes: 126

Distance: 100 m to 24 Km (with repeaters and fibre optic transmission)

Baud rate: 9600 to 12M bps

9.3 DATA EXCHANGE

The Master Profibus is usually a PLC (Siemens S7 or others) but it could be a PC based device as well. The Profibus Controller is always Slave in the Profibus network.

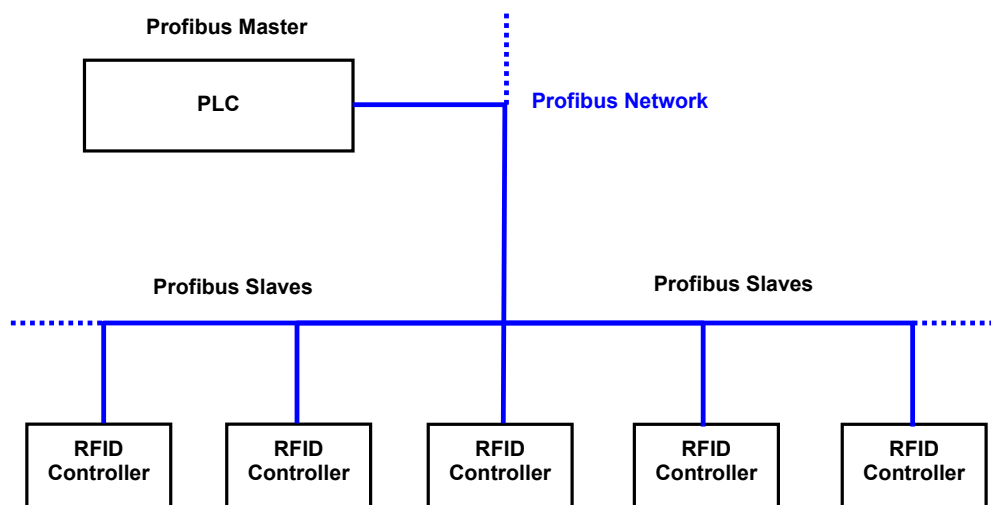


Figure 66 - Profibus-DP Network Diagram

Basically two shared memory areas (Exchange Areas) are used to exchange information between the SLAVE and the MASTER, both devices provide information to each other.

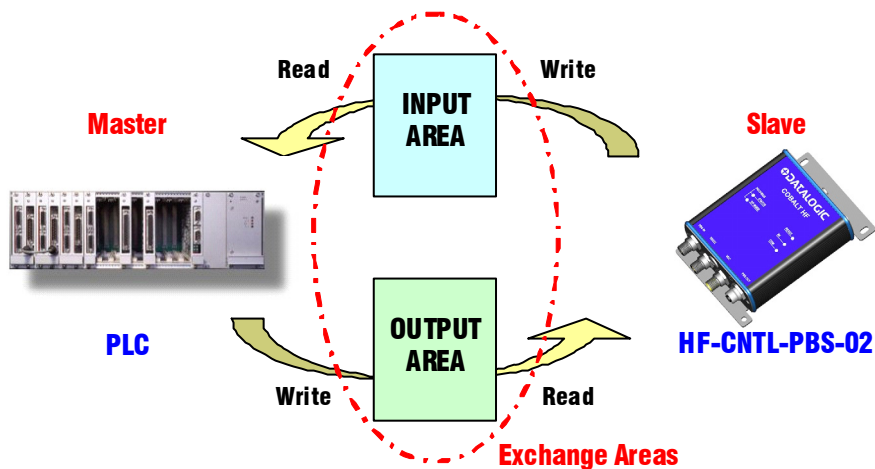


Figure 67 - Profibus Communication – Data Exchange Areas Diagram

Input and Output areas always refer to the Master: this means that the Controller writes to the Input buffer and the PLC writes to the Output buffer.

The dimension of the exchange areas can be set to different values by the PLC through the GSD file: the Profibus Controller allows up to **152 bytes as a combined total of the Input and Output Areas**.



NOTE

For further information regarding Fieldbus interfacing including downloadable support files, go to the HMS website at <http://www.anybus.com>, choose the link to the support page, select the Anybus-CompactCom product type and then your network type.

9.4 PROTOCOL IMPLEMENTATION

9.4.1 Definitions

In the protocol description we'll use the following definitions:

- Input field: is the set of master inputs that can be modified by the specific slave
- Output field: is the set of master outputs that can be read by the specific slave
- MaxInBytes: is the number of input bytes shared by the master and the specific slave
- MaxOutBytes: is the number of output bytes shared by the master and the specific slave
- IN[Nin] represent the input byte number Nin, where numbering starts from 0 to MaxInBytes-1
- OUT[Nout] represent the output byte number Nout, where numbering starts from 0 to MaxOutBytes-1

Obviously, MaxInBytes and MaxOutBytes are respectively the configured **INPUT** and **OUTPUT AREA** sizes.

The I/O Exchange Areas are actually updated and read every 30 ms at the Profibus Controller side. So after an RFID tag is read the worst delivery time from the Profibus Controller to the Master station is about 30 ms plus the intrinsic PROFIBUS DP delay and the Master delay.

This product implements the Datalogic AnyBus Driver (DAD) which is a layer that is built upon the intrinsic fieldbus data exchange mechanism. The Driver is needed to add features such as flow control and fragmentation.

In order to implement the flow controlled version of the driver, I/O Exchange Areas must be congruently compiled in both directions. **INPUT** Area is the Exchange buffer from Profibus Controller to the Master while **OUTPUT** Area is the exchange buffer from the Master to the Profibus Controller. Only the first three bytes are used by the Datalogic AnyBus Driver layer in both buffers for the extended protocol.

These are:

byte 0: **Control Field**, used to issue and control the Datalogic AnyBus Driver primitives such as flowcontrol, fragmentation and resynchronization;

byte 1: **Service Access Point Field**, used to distinguish among different services but also to provide future expandability. Since this SAP definition is introduced by the Datalogic AnyBus Driver, it must not be confused with the AnyBus SAP that is defined by the international standard.

byte 2: **Length Field**, that contains the number of bytes used by the application layer. This number must always be less than or equal to MaxInBytes-3 for the IN[] buffer and less than or equal to MaxOutBytes-3 for the OUT[] buffer.

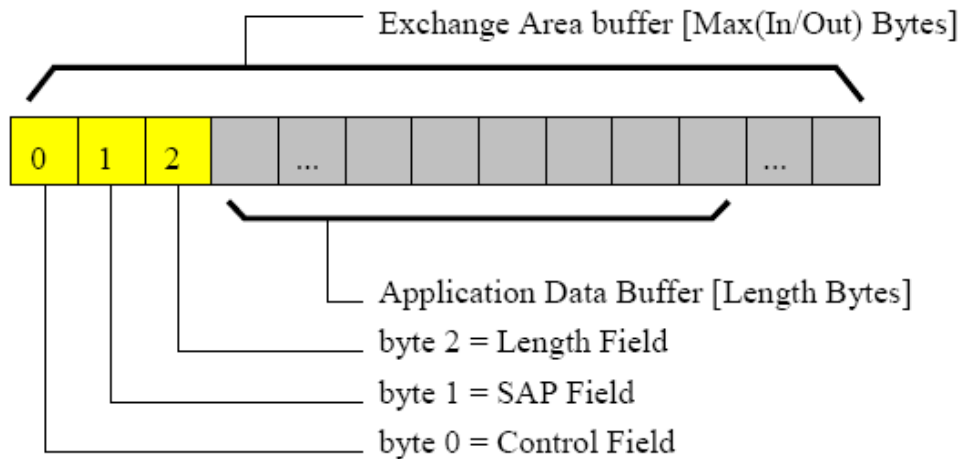


Figure 68 - Exchange Area Buffer Structure

9.4.2 Control Field

The Input field structure reserves IN[0] for handshake purposes: bit 0 and bit 1 are used for this. Bit 6 is set to 1 in order to specify the messaging protocol number 1 is in use. The Output field structure is symmetrical, and reserves bit 0 and 1 for handshake purposes. Bit 6 is set to 1 in order to specify the messaging protocol number 1 is in use. Bit 2 of the Output buffer is used to request a clear of the synchronization numbers (bit 0 and bit 1 of both Input and Output buffers).

This is called a resynchronization request and it is always initiated by the Master Station. The Slave must acknowledge the request, using bit 2 of the Input buffer. Bit 3 is used to control a fragmentation sequence in both directions.

More precisely,

function of the IN[0] byte:

IN[0].bit0 = TxBufferFull, toggles when new data is available on IN[1] .. IN[Nin] input area

IN[0].bit1 = RxBufferEmpty, toggles when rx block has been read on OUT[1] .. OUT[Nout]

IN[0].bit2 = Resync Acknowledge, set to 1 as an acknowledge to a resync request.

IN[0].bit3 = More Bit, it must be set to 1 when this is not the last piece of a fragmentation sequence. It must be set to 0 when this is the last piece of a fragmentation sequence.

IN[0].bit4,5,7 = set to 0,0,0 when this messaging protocol is used.

IN[0].bit6 = set to 1 when this messaging protocol is used.

function of the OUT[0] byte:

OUT[0].bit0 = TxBufferEmpty, toggles when transmitted data block has been read from master.

OUT[0].bit1 = RxBufferFull, toggles when new data block is available from master.

OUT[0].bit2 = Resync Request, set to 1 for 1 second to resynchronize a slave. After resynchronization, all 4 handshake bits are set to 0 and next toggle brings them to 1.

OUT[0].bit3 = More Bit, it must be set to 1 when this is not the last piece of a fragmentation sequence. It must be set to 0 when this is the last piece of a fragmentation sequence.

OUT[0].bit4,5,7 = set to 0,0,0 when this messaging protocol is used.

OUT[0].bit6 = set to 1 when this messaging protocol is used.

The following figure shows how it is possible to exchange messages with flow control using bit 0 and bit 1 in the IN/OUT buffers.

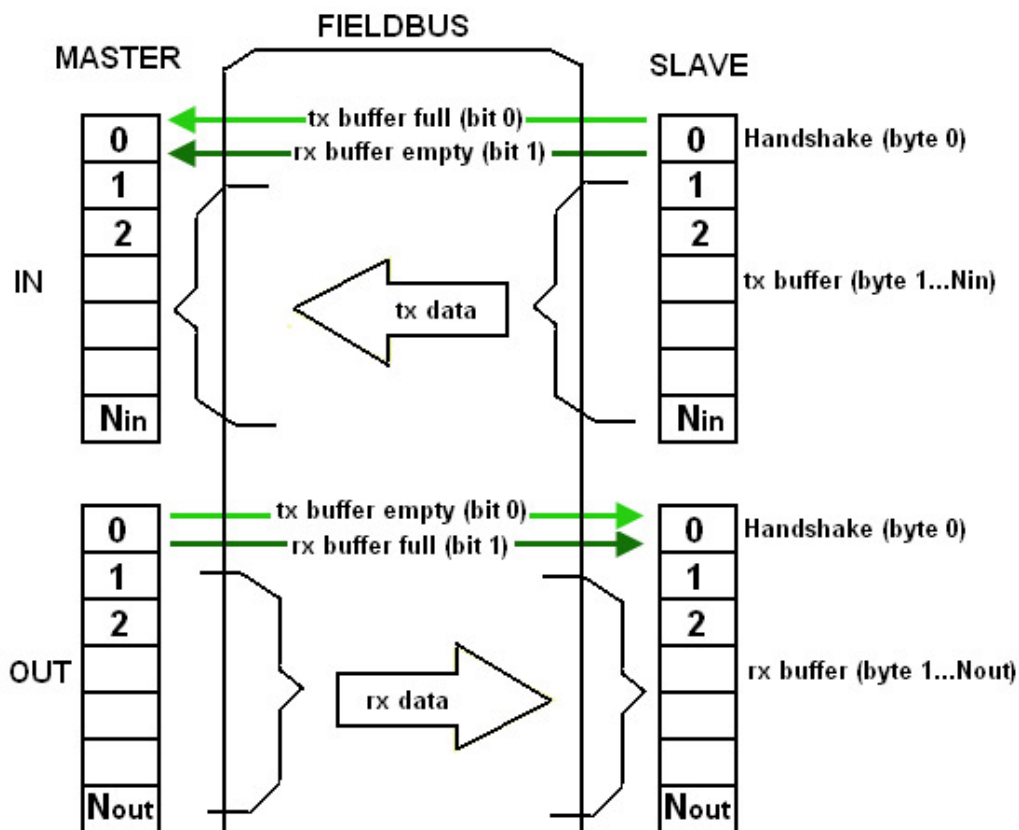


Figure 69 - Message Exchange with Flow Control

Data Transmission Slave → Master

The transmission state machine is shown to understand how a single block is transmitted and received. This protocol guarantees a basic flow control mechanism from slave to master.

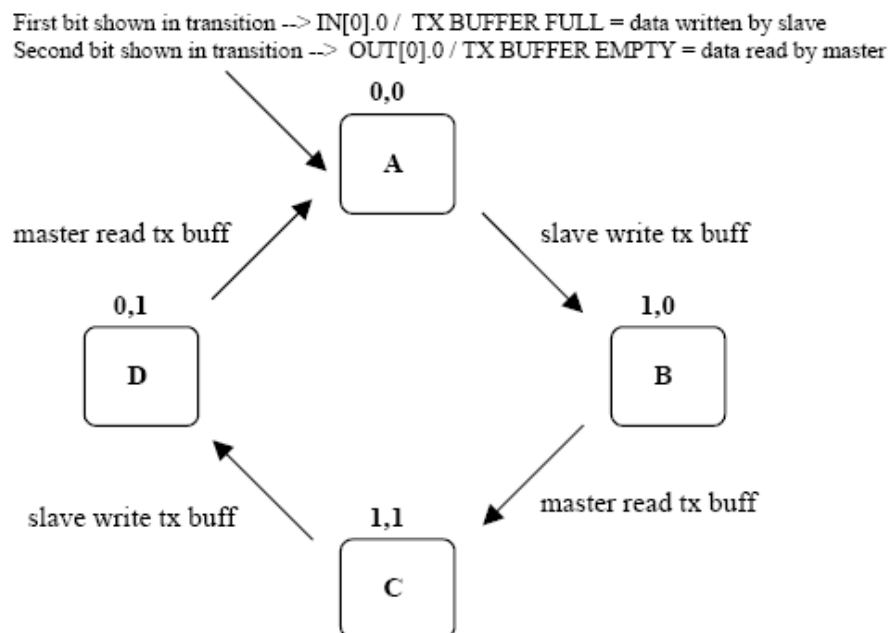


Figure 70 - Slave to Master Transmission State Machine

Data Transmission Master → Slave

The receive state machine is shown to understand how a single block is transmitted by the master and received by a slave. This protocol guarantees a basic flow control mechanism from master to slave.

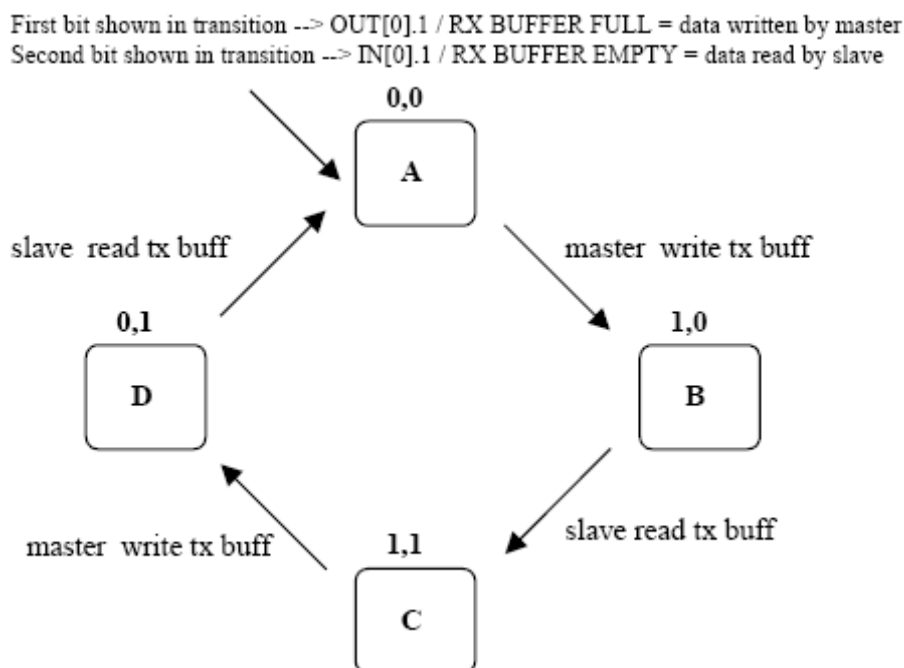


Figure 71 - Master to Slave Reception State Machine

Resynchronization Protocol

Resynchronization may be used at the master startup, both to detect if a slave is on line or not, or to restart the messaging protocol from a predefined state. It is also used during normal operations in case of errors requiring a protocol reset procedure to be started.

Bits order :

- OUT[0].bit2 = Sync request - IN[0].bit2 = Sync acknowledge

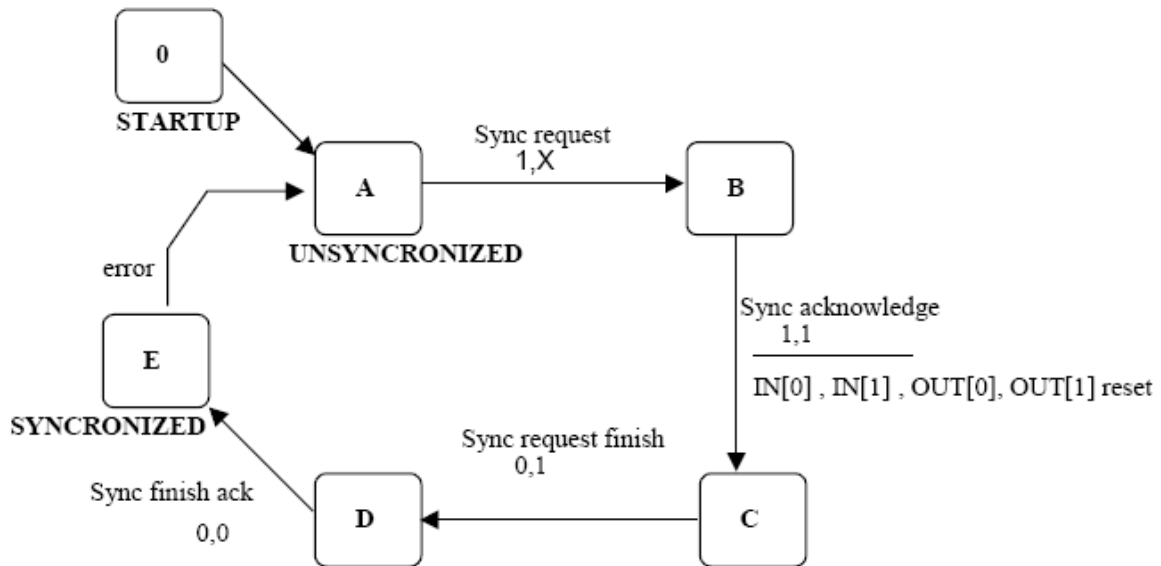


Figure 72 - Resynchronization State Machine

9.4.3 SAP Field

SAP (Service Access Point) is an identifier that is used to share the same communication channel between processes of two remote stations. This allows splitting the single service into different services.

SAP = 0 is actually used by the slave to transfer acquisition information; it should also be used to transfer application data from Master to Slave.

SAP = 2 is currently reserved.

SAP = 255 is currently reserved.

Only SAP 255 and 2 are reserved. All other SAPs are free and may be used by new application programs.

9.4.4 Length Field

The Application layer uses all or a part of the remaining bytes of the Exchange Area buffers that are not used by the Datalogic AnyBus Driver. The Length Field is introduced to keep the information of how many bytes are really used by the Application Layer. A fragment that is not the last one of a fragmentation sequence must fill this field with $\text{Max(In/Out)Bytes}-3$, depending on whether it is an INPUT/OUTPUT fragment. Otherwise this field is filled with a number that is less than or equal to $\text{Max(In/Out)Bytes}-3$.

9.4.5 Application Data Buffer

The Application data buffer holds the CBx commands described in the CBx Command Protocol Reference Manual.

9.5 EXAMPLES OF PROFIBUS COMMAND/RESPONSE MECHANISM

As seen in par. 9.3, there are two buffers – an OUTPUT Buffer that is controlled by the MASTER, and an INPUT Buffer that is controlled by the slave (the Controller).

The **OUTPUT Buffer** is mapped the following way:

Output Buffer	
Byte #	
00:	OUTPUT BUFFER CONTROL BYTE (OBCB)
01:	(Always 0)
02:	Packet Length in Bytes
03:	Packet Bytes (Command)
04:	" "
05:	" "
06:	" "
07:	" "
08:	" "
09:	" "
10:	" "
-	" "
-	" "
N-2:	" "
N-1:	Data Consistency Byte (OBDCB)

Byte 0 is the **Output Buffer Control Byte**. The Master uses the lowest two bits of this byte for handshaking: to signal that a command is ready for the slave (**Bit 1**), and to acknowledge receiving a response from the slave (**Bit 0**).

OUTPUT BUFFER CONTROL BYTE							
7	6	5	4	3	2	1	0
[1]	[0]	[0]	[0]	[0]	[0]	[0]	[0]

Bit 0 is toggled by the Master to acknowledge a packet (response) from the RFID Controller.

Bit 1 is toggled by the Master when it has a packet (command) ready for the RFID Controller.

Bit 2 is set when the Master wishes to initiate a “Resynchronization” with the Slave, and then cleared when it sees the corresponding handshake from the Slave, (indicating that the resynchronization is complete).

Bit 3 is set by the Slave when the total CBx response being returned to the Master is larger than the space available in the Input Buffer (or that the packet being returned is a fragment, and that there are more fragments to follow). This bit is cleared for the final fragment of a fragmented response – and so the Master can know when all the fragments of a response have been returned from the Slave.

Bit 7 is always 1, to conform to Datalogic's proprietary "DAD" Protocol.

Byte 1: is always 0.

Byte 2: contains the length of the packet in bytes (CBx Command or Command Fragment) to be sent to the RFID Controller. This can be the length of an entire CBx command, or the length of a fragment of a command, if the CBx command is larger than the space allowed to send it in a single fragment.

Byte 3 through Byte N-2 are used for the actual CBx Command or Command Fragment to be sent.

Byte N-1: the final byte of the Output Buffer is the **Data Consistency Byte**. It is a copy of the **Output Buffer Control Byte**. When changes to the Control Byte are made, the same changes must also be made in the Data Consistency Byte, before the changes "take effect". This is to guarantee the validity of the data between the two bytes.

The **INPUT Buffer** is controlled by the Slave (Cobalt RFID Controller) and is mapped the same way, except for the packet bytes containing a response (or response fragment) from the controller.

Input Buffer	
Byte #	
00:	INPUT BUFFER CONTROL BYTE (IBCB)
01:	(Always 0)
02:	Packet Length in Bytes
03:	Packet Bytes (Response)
04:	" "
05:	" "
06:	" "
07:	" "
08:	" "
09:	" "
10:	" "
-	" "
-	" "
N-2:	" "
N-1:	Data Consistency Byte (IBDCB)

Byte 0 is the **Input Buffer Control Byte**. The Slave uses the lowest four bits of this byte for handshaking: to acknowledge receiving a command from the master (Bit 1), and to signal that a response is ready for the master (Bit 0).

INPUT BUFFER CONTROL BYTE							
7	6	5	4	3	2	1	0
[1]	[0]	[0]	[0]	[0]	[0]	[0]	[0]

Bit 0 is toggled by the Slave when it has a new packet (response or response fragment) ready for the Master.

Bit 1 is toggled by the Slave to acknowledge a packet (command or command fragment) from the Master.

Bit 2 is set by the Slave after it completes resynchronization, and then cleared once the Master has acknowledged that resynchronization is complete.

Bit 3 is set by the Slave when the total CBx response being returned to the Master is larger than the space available in the Input Buffer (or that the packet being returned is a fragment, and that there are more fragments to follow). This bit is cleared for the final fragment of a fragmented response – and so the Master can know when all the fragments of a response have been returned from the Slave.

Bit 7 is set to 1 as soon as the Slave has been successfully initialized at power-up, and remains at 1, to conform to Datalogic's proprietary "DAD" Protocol.

Byte 1: is always 0.

Byte 2: contains the length of the packet in bytes (CBx response or response fragment) to be sent back to the Master.

Byte 3 through Byte N-2 are used for the actual CBx response or response fragment to be sent.

Byte N-1: The final byte of the Input Buffer is the Data Consistency Byte for the Input Buffer. It is a copy of the Input Buffer Control Byte. The Master should check that these two bytes are the same, before considering the Input Buffer's data to be valid.

**NOTE**

The input and output buffers can exceed 64 bytes. The combined total of the input and output buffers cannot exceed 152 bytes.

9.5.1 Example 1: Normal Command/Response Sequence

For this example, the Master will send a CBx "Read Tag ID" command to the Slave (the RFID Controller) to read an 8-byte tag ID from an RFID Tag. First we will see a "Tag Not Found" error (assuming that the tag is not read) and then we will see a successful read of the Tag ID.

We will assume for this example that both the Input and Output Buffers have been configured to 32 bytes each. This means that the controllers response (for this command) can fit entirely in the input buffer, and no fragmentation is required.

Sending the command:

In **Byte 2** of the output buffer the Master places the length (in bytes) of the data packet (CBx Command) we are sending. In this case the CBx command we are sending is 12 bytes. This length is the length of the command bytes we are interested in sending, not the full size of the buffer. The length also does not include the "Data Consistency Byte" at the end of the buffer. That is just a mirror of the Control Byte.

In **Byte 3** through **Byte 14** the Master places the 12 bytes of this particular CBx command. Some CBx commands are larger, but all will be at least 12 bytes, even if some of those 12 bytes are not actually used.

(See the **Green** changes below)

Output Buffer			Input Buffer		
Byte #	Value		Byte #	Value	
		Output Buffer Control Byte (OBCB)			Input Buffer Control Byte (IBCB)
00:	80	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [0] [0] [0]	00:	80	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [0] [0] [0]
01:	00	(Always 0)	01:	00	
02:	0C	(Packet length in bytes)	02:	00	
03:	00	(CBx Command word length MSB)	03:	00	
04:	06	(CBx Command word length LSB) Minimum of 6 words	04:	00	
05:	AA	(CBx Command Type) Always AA	05:	00	
06:	07	(CBx Command Opcode) 0x07 = Read Tag ID	06:	00	
07:	00	(CBx Command, byte not used)	07:	00	
08:	01	(CBx Command "Node ID")	08:	00	
09:	03	(CBx Command Timeout MSB)	09:	00	
10:	E8	(CBx Command Timeout LSB) 0xE8 = 1000 ms timeout	10:	00	
11:	00	(CBx Command Not Used)	11:	00	
12:	00	(CBx Command Not Used)	12:	00	
13:	00	(CBx Command Not Used)	13:	00	
14:	00	(CBx Command Not Used)	14:	00	
15:	00		15:	00	
16:	00		16:	00	
17:	00		17:	00	
18:	00		18:	00	
19:	00		19:	00	
20:	00		20:	00	
..	..		..	..	
30:	00		30:	00	
31:	80	Data Consistency Byte (OBDCB)	31:	80	Data Consistency Byte (IBDCB)

Now that the command is in the Output Buffer, The Master alerts the Slave that the command is ready. It does this by toggling **Bit 1** of the **Output Buffer Control Byte** (the **OBCB**) and then also toggling the same bit in the **Output Buffer Data Consistence Byte** (the **OBDCB**).



NOTE

This bit is a toggle. So if it is 0, it is toggled to 1 to indicate a new command. If it is 1, it is toggled to 0 to indicate a new command. If the bit is 1, setting it to 0, and then back to 1 will cause the command to be issued twice.

(See the **Green** changes below)

Output Buffer			Input Buffer		
Byte #	Value		Byte #	Value	
		Output Buffer Control Byte (OBCB)			Input Buffer Control Byte (IBCB)
00:	82	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [0] [1] [0]	00	80	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [0] [0] [0]
01:	00	(Always 0)	01:	00	
02:	0C	(Packet length in bytes)	02:	00	
03:	00	(CBx Command word length MSB)	03:	00	
04:	06	(CBx Command word length LSB)	04:	00	
05:	AA	(CBx Command Type)	05:	00	
06:	07	(CBx Command Opcode)	06:	00	
07:	00	(CBx Command, byte not used)	07:	00	
08:	01	(CBx Command "Node ID")	08:	00	
09:	03	(CBx Command Timeout MSB)	09:	00	
10:	E8	(CBx Command Timeout LSB)	10:	00	
11:	00	(CBx Command Not Used)	11:	00	
12:	00	(CBx Command Not Used)	12:	00	
13:	00	(CBx Command Not Used)	13:	00	
14:	00	(CBx Command Not Used)	14:	00	
15:	00		15:	00	
16:	00		16:	00	
17:	00		17:	00	
18:	00		18:	00	
19:	00		19:	00	
20:	00		20:	00	
..	..		..	..	
30:	00		30:	00	
31:	82	Data Consistency Byte (OBDCB)	31:	80	Data Consistency Byte (IBDCB)

When the Slave sees Bit 1 of the **OBCB & OBDCB** toggle, it grabs the command from the **Output Buffer**. The Slave then acknowledges the command by toggling **Bit 1** of the **Input Buffer Control Byte** (the **IBCB**) and also the same bit of the **Input Buffer Data Consistency Byte** (the **IBDCB**).

(See the **Green** changes below)

Output Buffer			Input Buffer		
Byte #	Value		Byte #	Value	
		Output Buffer Control Byte (OBCB)			Input Buffer Control Byte (IBCB)
00:	82	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [0] [1] [0]	00:	82	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [0] [1] [0]
01:	00	(Always 0)	01:	00	
02:	0C	(Packet length in bytes)	02:	00	
03:	00	(CBx Command word length MSB)	03:	00	
04:	06	(CBx Command word length LSB)	04:	00	
05:	AA	(CBx Command Type)	05:	00	
06:	07	(CBx Command Opcode)	06:	00	
07:	00	(CBx Command, byte not used)	07:	00	
08:	01	(CBx Command "Node ID")	08:	00	
09:	03	(CBx Command Timeout MSB)	09:	00	
10:	E8	(CBx Command Timeout LSB)	10:	00	
11:	00	(CBx Command Not Used)	11:	00	
12:	00	(CBx Command Not Used)	12:	00	
13:	00	(CBx Command Not Used)	13:	00	
14:	00	(CBx Command Not Used)	14:	00	
15:	00		15:	00	
16:	00		16:	00	
17:	00		17:	00	
18:	00		18:	00	
19:	00		19:	00	
20:	00		20:	00	
..	..		..	..	
30:	00		30:	00	
31:	82	Data Consistency Byte (OBDCB)	31:	82	Data Consistency Byte (IBDCB)

The Slave writes the response into the **Input Buffer**, and toggles **Bit 0** of the **IBCB** to indicate that there is a response fragment ready for the master. Since the entire response fits in the buffer, it does not need to use fragmentation. The Slave also simultaneously makes the same changes to the **IBDCB**.

(See the **Green** changes below)

Output Buffer			Input Buffer		
Byte #	Value		Byte #	Value	
		Output Buffer Control Byte (OBCB)			Input Buffer Control Byte (IBCB)
00:	82	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [0] [1] [0]	00:	83	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [0] [1] [1]
01:	00	(Always 0)	01:	00	(Always 0)
02:	0C	(Packet length in bytes)	02:	0E	(Packet length in bytes)
03:	00	(CBx Command word length MSB)	03:	00	(CBx Response word length MSB)
04:	06	(CBx Command word length LSB)	04:	07	(CBx Response word length LSB)
05:	AA	(CBx Command Type)			Minimum of 6 words
06:	07	(CBx Command Opcode)	05:	FF	(CBx Response Type) FF=Error
07:	00	(CBx Command, byte not used)	06:	FF	(CBx Response Opcode) FF=Error
08:	01	(CBx Command "Node ID")	07:	00	(CBx Response Instance Counter)
09:	03	(CBx Command Timeout MSB)	08:	01	(CBx Response "Node ID")
10:	E8	(CBx Command Timeout LSB)	09:	01	(CBx Response Timestamp Month)
11:	00	(CBx Command Not Used)	10:	01	(CBx Response Timestamp Day)
12:	00	(CBx Command Not Used)	11:	00	(CBx Response Timestamp Hour)
13:	00	(CBx Command Not Used)	12:	13	(CBx Response Timestamp Minute)
14:	00	(CBx Command Not Used)	13:	22	(CBx Response Timestamp Second)
15:	00		14:	01	(CBx Response "Data length")
16:	00				1 byte (the Error Code)
17:	00		15:	07	(CBx Response Data Byte 1)
18:	00				Error Code 7 = Tag Not Found
19:	00		16:	00	(CBx Response byte not used)
20:	00		17:	00	
21:	00		18:	00	
22:	00		19:	00	
23:	00		20:	00	
24:	00		21:	00	
25:	00		22:	00	
26:	00		23:	00	
27:	00		24:	00	
28:	00		25:	00	
29:	00		26:	00	
30:	00		27:	00	
31:	82	Data Consistency Byte (OBDCB)	31:	83	Data Consistency Byte (IBDCB)

In this case, the response is a "Tag Not Found" error.

The Master can see that **Bit 0** of the **IBCB & IBDCB** has been toggled, so it knows that the response in the Input Buffer is ready. Since **Bit 2** of the **IBCB & IBDCB** is **not** set to 1, it knows that the response is complete (not a fragment).

The Master now toggles **Bit 0** of the **OBCB & OBDCB** to acknowledge that it has received the response.

(See the **Green** changes below)

Output Buffer			Input Buffer		
Byte #	Value		Byte #	Value	
		Output Buffer Control Byte (OBCB)			Input Buffer Control Byte (IBCB)
00:	83	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [0] [1] [1]	00:	83	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [0] [1] [1]
01:	00	(Always 0)	01:	00	(Always 0)
02:	0C	(Packet length in bytes)	02:	0E	(Packet length in bytes)
03:	00	(CBx Command word length MSB)	03:	00	(CBx Response word length MSB)
04:	06	(CBx Command word length LSB)	04:	07	(CBx Response word length LSB)
05:	AA	(CBx Command Type)			Minimum of 6 words
06:	07	(CBx Command Opcode)	05:	FF	(CBx Response Type) FF=Error
07:	00	(CBx Command, byte not used)	06:	FF	(CBx Response Opcode) FF=Error
08:	01	(CBx Command "Node ID")	07:	00	(CBx Response Instance Counter)
09:	03	(CBx Command Timeout MSB)	08:	01	(CBx Response "Node ID")
10:	E8	(CBx Command Timeout LSB)	09:	01	(CBx Response Timestamp Month)
11:	00	(CBx Command Not Used)	10:	01	(CBx Response Timestamp Day)
12:	00	(CBx Command Not Used)	11:	00	(CBx Response Timestamp Hour)
13:	00	(CBx Command Not Used)	12:	13	(CBx Response Timestamp Minute)
14:	00	(CBx Command Not Used)	13:	22	(CBx Response Timestamp Second)
15:	00		14:	01	(CBx Response "Data length")
16:	00				1 byte (the Error Code)
17:	00		15:	07	(CBx Response Data Byte 1)
18:	00				Error Code 7 = Tag Not Found
19:	00		16:	00	(CBx Response byte not used)
20:	00		17:	00	
21:	00		18:	00	
22:	00		19:	00	
23:	00		20:	00	
24:	00		21:	00	
25:	00		22:	00	
26:	00		23:	00	
27:	00		24:	00	
28:	00		25:	00	
29:	00		26:	00	
30:	00		27:	00	
31:	83	Data Consistency Byte (OBDCB)	31:	83	Data Consistency Byte (IBDCB)

The command/response sequence has completed. A command has been issued and the response received (in this case, a "Tag Not Found" error) and the response has been acknowledged.

If we now place a tag on the controller's antenna, we can reissue the same command by toggling **Bit 1** of the **OBCB & OBDCB** again.

(See the **Green** changes below)

Output Buffer			Input Buffer		
Byte #	Value		Byte #	Value	
		Output Buffer Control Byte (OBCB)			Input Buffer Control Byte (IBCB)
00:	81	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [0] [0] [1]	00:	83	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [0] [0] [1]
01:	00	(Always 0)	01:	00	(Always 0)
02:	0C	(Packet length in bytes)	02:	0E	(Packet length in bytes)
03:	00	(CBx Command word length MSB)	03:	00	(CBx Response word length MSB)
04:	06	(CBx Command word length LSB)	04:	07	(CBx Response word length LSB)
05:	AA	(CBx Command Type)			Minimum of 6 words
06:	07	(CBx Command Opcode)	05:	FF	(CBx Response Type) FF=Error
07:	00	(CBx Command, byte not used)	06:	FF	(CBx Response Opcode) FF=Error
08:	01	(CBx Command "Node ID")	07:	00	(CBx Response Instance Counter)
09:	03	(CBx Command Timeout MSB)	08:	01	(CBx Response "Node ID")
10:	E8	(CBx Command Timeout LSB)	09:	01	(CBx Response Timestamp Month)
11:	00	(CBx Command Not Used)	10:	01	(CBx Response Timestamp Day)
12:	00	(CBx Command Not Used)	11:	00	(CBx Response Timestamp Hour)
13:	00	(CBx Command Not Used)	12:	13	(CBx Response Timestamp Minute)
14:	00	(CBx Command Not Used)	13:	22	(CBx Response Timestamp Second)
15:	00		14:	01	(CBx Response "Data length")
16:	00				1 byte (the Error Code)
17:	00		15:	07	(CBx Response Data Byte 1)
18:	00				Error Code 7 = Tag Not Found
19:	00		16:	00	(CBx Response byte not used)
20:	00		17:	00	
21:	00		18:	00	
22:	00		19:	00	
23:	00		20:	00	
24:	00		21:	00	
25:	00		22:	00	
26:	00		23:	00	
27:	00		24:	00	
28:	00		25:	00	
29:	00		26:	00	
30:	00		27:	00	
31:	81	Data Consistency Byte (OBDCB)	31:	83	Data Consistency Byte (IBDCB)

The controller will toggle **Bit 1** of the **IBCB & IBDCB** to indicate it has received the command.

(See the **Green** changes below)

Output Buffer			Input Buffer		
Byte #	Value		Byte #	Value	
		Output Buffer Control Byte (OBCB)			Input Buffer Control Byte (IBCB)
00:	81	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [0] [0] [1]	00:	81	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [0] [0] [0] [1]
01:	00	(Always 0)	01:	00	(Always 0)
02:	0C	(Packet length in bytes)	02:	0E	(Packet length in bytes)
03:	00	(CBx Command word length MSB)	03:	00	(CBx Response word length MSB)
04:	06	(CBx Command word length LSB)	04:	07	(CBx Response word length LSB)
05:	AA	(CBx Command Type)			Minimum of 6 words
06:	07	(CBx Command Opcode)	05:	FF	(CBx Response Type) FF=Error
07:	00	(CBx Command, byte not used)	06:	FF	(CBx Response Opcode) FF=Error
08:	01	(CBx Command "Node ID")	07:	00	(CBx Response Instance Counter)
09:	03	(CBx Command Timeout MSB)	08:	01	(CBx Response "Node ID")
10:	E8	(CBx Command Timeout LSB)	09:	01	(CBx Response Timestamp Month)
11:	00	(CBx Command Not Used)	10:	01	(CBx Response Timestamp Day)
12:	00	(CBx Command Not Used)	11:	00	(CBx Response Timestamp Hour)
13:	00	(CBx Command Not Used)	12:	13	(CBx Response Timestamp Minute)
14:	00	(CBx Command Not Used)	13:	22	(CBx Response Timestamp Second)
15:	00		14:	01	(CBx Response "Data length")
16:	00				1 byte (the Error Code)
17:	00		15:	07	(CBx Response Data Byte 1)
18:	00				Error Code 7 = (Tag Not Found)
19:	00		16:	00	(CBx Response byte not used)
20:	00		17:	00	
21:	00		18:	00	
22:	00		19:	00	
23:	00		20:	00	
24:	00		21:	00	
25:	00		22:	00	
26:	00		23:	00	
27:	00		24:	00	
28:	00		25:	00	
29:	00		26:	00	
30:	00		27:	00	
31:	81	Data Consistency Byte (OBDCB)	31:	81	Data Consistency Byte (IBDCB)

We will assume that the Slave successfully reads the RFID tag.

The Slave writes the response into the Input Buffer, and toggles **Bit 0** of the **IBCB & IBDCB** to indicate that the response is ready.



NOTE

If the master has not acknowledged receiving the previous response, the controller will not be able to place the response in the Input Buffer.

(See the **Green** changes below)

Output Buffer			Input Buffer		
Byte #	Value		Byte #	Value	
		Output Buffer Control Byte (OBCB)			Input Buffer Control Byte (IBCB)
00:	81	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [0] [0] [1]	00:	80	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [0] [0] [0]
01:	00	(Always 0)	01:	00	(Always 0)
02:	0C	(Packet length in bytes)	02:	14	(Packet length in bytes)
03:	00	(CBx Command word length MSB)	03:	00	(CBx Response word length MSB)
04:	06	(CBx Command word length LSB)	04:	0A	(CBx Response word length LSB) Minimum of 6 words
05:	AA	(CBx Command Type)	05:	AA	(CBx Response Type) AA=Normal Response
06:	07	(CBx Command Opcode)	06:	07	(CBx Response Opcode) 07=Command Echo of Tag Read ID
07:	00	(CBx Command, byte not used)	07:	01	(CBx Response Instance Counter)
08:	01	(CBx Command "Node ID")	08:	01	(CBx Response "Node ID")
09:	03	(CBx Command Timeout MSB)	09:	01	(CBx Response Timestamp Month)
10:	E8	(CBx Command Timeout LSB)	10:	01	(CBx Response Timestamp Day)
11:	00	(CBx Command Not Used)	11:	01	(CBx Response Timestamp Hour)
12:	00	(CBx Command Not Used)	12:	17	(CBx Response Timestamp Minute)
13:	00	(CBx Command Not Used)	13:	58	(CBx Response Timestamp Second)
14:	00	(CBx Command Not Used)	14:	08	(CBx Response "Data length") 8 bytes (the Tag ID)
15:	00		15:	E0	(CBx Response Data Byte 1) Tag ID Byte 1
16:	00		16:	04	(CBx Response Data Byte 2) Tag ID Byte 2
17:	00		17:	01	(CBx Response Data Byte 3) Tag ID Byte 3
18:	00		18:	00	(CBx Response Data Byte 4) Tag ID Byte 4
19:	00		19:	0E	(CBx Response Data Byte 5) Tag ID Byte 5
20:	00		20:	20	(CBx Response Data Byte 6) Tag ID Byte 6
21:	00		21:	DD	(CBx Response Data Byte 7) Tag ID Byte 7
22:	00		22:	AF	(CBx Response Data Byte 8) Tag ID Byte 8
23:	00		23:	00	
24:	00		24:	00	
25:	00		25:	00	
26:	00		26:	00	
27:	00		27:	00	
28:	00		28:	00	
29:	00		29:	00	
30:	00		30:	00	
31:	81	Data Consistency Byte (OBDCB)	31:	80	Data Consistency Byte (IBDCB)

You can see the Tag ID in the data portion of the CBx response, Tag ID **E00401000E20DDAF**.

The Master can see that **Bit 0** of the **IBCB & IBDCB** has been toggled, so it knows that the response in the Input Buffer is ready. Since **Bit 2** is not set to 1, it knows that the response is complete (not a fragment).

The Master now toggles **Bit 0** of the **OBCB** & **OBDCB** to acknowledge that it has received the response.

(See the **Green** changes below)

Output Buffer			Input Buffer		
Byte #	Value		Byte #	Value	
		Output Buffer Control Byte (OBCB)			Input Buffer Control Byte (IBCB)
00:	80	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [0] [0] [0] [0]	00:	80	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [0] [0] [0]
01:	00	(Always 0)	01:	00	(Always 0)
02:	0C	(Packet length in bytes)	02:	14	(Packet length in bytes)
03:	00	(CBx Command word length MSB)	03:	00	(CBx Response word length MSB)
04:	06	(CBx Command word length LSB)	04:	0A	(CBx Response word length LSB)
05:	AA	(CBx Command Type)			Minimum of 6 words
06:	07	(CBx Command Opcode)	05:	AA	(CBx Response Type)
07:	00	(CBx Command, byte not used)			AA=Normal Response
08:	01	(CBx Command "Node ID")	06:	07	(CBx Response Opcode)
09:	03	(CBx Command Timeout MSB)			07=Command Echo of Tag Read ID
10:	E8	(CBx Command Timeout LSB)	07:	01	(CBx Response Instance Counter)
11:	00	(CBx Command Not Used)	08:	01	(CBx Response "Node ID")
12:	00	(CBx Command Not Used)	09:	01	(CBx Response Timestamp Month)
13:	00	(CBx Command Not Used)	10:	01	(CBx Response Timestamp Day)
14:	00	(CBx Command Not Used)	11:	01	(CBx Response Timestamp Hour)
15:	00		12:	17	(CBx Response Timestamp Minute)
16:	00		13:	58	(CBx Response Timestamp Second)
17:	00		14:	08	(CBx Response "Data length")
18:	00				8 bytes (the Tag ID)
19:	00		15:	E0	(CBx Response Data Byte 1)
20:	00				Tag ID Byte 1
21:	00		16:	04	(CBx Response Data Byte 2)
22:	00				Tag ID Byte 2
23:	00		17:	01	(CBx Response Data Byte 3)
24:	00				Tag ID Byte 3
25:	00		18:	00	(CBx Response Data Byte 4)
26:	00				Tag ID Byte 4
27:	00		19:	0E	(CBx Response Data Byte 5)
28:	00				Tag ID Byte 5
29:	00		20:	20	(CBx Response Data Byte 6)
30:	00				Tag ID Byte 6
31:	80	Data Consistency Byte (OBDCB)	21:	DD	(CBx Response Data Byte 7)
					Tag ID Byte 7
			22:	AF	(CBx Response Data Byte 8)
					Tag ID Byte 8
			30:	00	
			31:	80	Data Consistency Byte (IBDCB)

The command/response sequence has completed. A command has been issued and the response received (in this case, a successful read of the RFID Tag ID) and the response has been acknowledged.

9.5.2 Example 2: Unsolicited Responses (Continuous Read Mode)

In some modes (such as Continuous Read Mode) the slave can generate unsolicited responses. If the Slave generates an unsolicited response, it will place the response in the Input Buffer, as long as the Master has acknowledged receiving the previous response. If the Master does not perform the handshake to acknowledge the previous response, the responses will accumulate in the internal memory buffer of the Slave (The RFID controller has an internal **2K buffer** for responses) and the responses will remain until the handshakes are performed for each response.

For this example, the controller automatically reads a tag (6 bytes of data), and places the “response” in the Input Buffer, and toggles **Bit 0** to indicate that a response is waiting.

Although no command was issued by the Master, we will still call this a “response”.

(See the **Green** changes below)

Output Buffer			Input Buffer		
Byte #	Value		Byte #	Value	
		Output Buffer Control Byte (OBCB)			Input Buffer Control Byte (IBCB)
00:	80	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [0] [0] [0]	00:	81	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [0] [0] [1]
01:	00	(Always 0)	01:	00	(Always 0)
02:	00	(Packet length in bytes)	02:	12	(Packet length in bytes)
03:	00		03:	00	(CBx Response word length MSB)
04:	00		04:	09	(CBx Response word length LSB)
05:	00		05:	AA	(CBx Response Type) AA=Normal Response
06:	00		06:	0D	(CBx Response Opcode) 0D=Continuous Read Response
07:	00		07:	01	(CBx Response Instance Counter)
08:	00		08:	01	(CBx Response "Node ID")
09:	00		09:	01	(CBx Response Timestamp Month)
10:	00		10:	01	(CBx Response Timestamp Day)
11:	00		11:	02	(CBx Response Timestamp Hour)
12:	00		12:	12	(CBx Response Timestamp Minute)
13:	00		13:	34	(CBx Response Timestamp Second)
14:	00		14:	06	(CBx Response "Data length") 6 bytes (the Tag ID)
15:	00		15:	11	(CBx Response Data Byte 1) Tag ID Byte 1
16:	00		16:	22	(CBx Response Data Byte 2) Tag ID Byte 2
17:	00		17:	33	(CBx Response Data Byte 3) Tag ID Byte 3
18:	00		18:	44	(CBx Response Data Byte 4) Tag ID Byte 4
19:	00		19:	55	(CBx Response Data Byte 5) Tag ID Byte 5
20:	00		20:	66	(CBx Response Data Byte 6) Tag ID Byte 6
..	..		..	..	
30:	00		30:	00	
31:	80	Data Consistency Byte (OBDCB)	31:	81	Data Consistency Byte (IBDCB)

The Master can see that **Bit 0** of the **IBCB & IBDCB** has been toggled, so it knows that a new response in the Input Buffer is ready (even though it hasn't issued a command).

Since **Bit 2** is not set to 1, it knows that the response is complete (not a fragment).

The Master now toggles **Bit 0** of the **OBCB & OBDCB** to acknowledge that it has received the response.

(See the **Green** changes below)

Output Buffer			Input Buffer		
Byte #	Value		Byte #	Value	
		Output Buffer Control Byte (OBCB)			Input Buffer Control Byte (IBCB)
00:	81	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [0] [0] [1]	00	81	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [0] [0] [1]
01:	00	(Always 0)	01:	00	(Always 0)
02:	00	(Packet length in bytes)	02:	12	(Packet length in bytes)
03:	00		03:	00	(CBx Response word length MSB)
04:	00		04:	09	(CBx Response word length LSB)
05:	00		05:	AA	Minimum of 6 words (CBx Response Type)
06:	00		06:	0D	AA=Normal Response (CBx Response Opcode)
07:	00		07:	01	0D=Continuous Read Response (CBx Response Instance Counter)
08:	00		08:	01	(CBx Response "Node ID")
09:	00		09:	01	(CBx Response Timestamp Month)
10:	00		10:	01	(CBx Response Timestamp Day)
11:	00		11:	02	(CBx Response Timestamp Hour)
12:	00		12:	12	(CBx Response Timestamp Minute)
13:	00		13:	34	(CBx Response Timestamp Second)
14:	00		14:	06	(CBx Response "Data length")
15:	00		15:	11	6 bytes (the Tag ID) (CBx Response Data Byte 1)
16:	00		16:	22	Tag ID Byte 1 (CBx Response Data Byte 2)
17:	00		17:	33	Tag ID Byte 2 (CBx Response Data Byte 3)
18:	00		18:	44	Tag ID Byte 3 (CBx Response Data Byte 4)
19:	00		19:	55	Tag ID Byte 4 (CBx Response Data Byte 5)
20:	00		20:	66	Tag ID Byte 5 (CBx Response Data Byte 6)
21:	00		21:	66	Tag ID Byte 6 (CBx Response Data Byte 6)
22:	00		22:	66	Tag ID Byte 6 (CBx Response Data Byte 6)
23:	00		23:	66	Tag ID Byte 6 (CBx Response Data Byte 6)
24:	00		24:	66	Tag ID Byte 6 (CBx Response Data Byte 6)
25:	00		25:	66	Tag ID Byte 6 (CBx Response Data Byte 6)
26:	00		26:	66	Tag ID Byte 6 (CBx Response Data Byte 6)
27:	00		27:	66	Tag ID Byte 6 (CBx Response Data Byte 6)
28:	00		28:	66	Tag ID Byte 6 (CBx Response Data Byte 6)
29:	00		29:	66	Tag ID Byte 6 (CBx Response Data Byte 6)
30:	00		30:	00	
31:	81	Data Consistency Byte (OBDCB)	31:	81	Data Consistency Byte (IBDCB)

The response has been acknowledged (a read of 6 bytes: 11 22 33 44 55 66).

The reader then reads another tag, puts another response in the Input Buffer, and toggles **Bit 0** again in the **IBCB & IBDCB**.

(See the **Green** changes below)

Output Buffer			Input Buffer		
Byte #	Value		Byte #	Value	
		Output Buffer Control Byte (OBCB)			Input Buffer Control Byte (IBCB)
00:	81	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [0] [0] [1]	00:	80	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [0] [0] [0]
01:	00	(Always 0)	01:	00	(Always 0)
02:	00	(Packet length in bytes)	02:	12	(Packet length in bytes)
03:	00		03:	00	(CBx Response word length MSB)
04:	00		04:	09	(CBx Response word length LSB)
05:	00				Minimum of 6 words
06:	00		05:	AA	(CBx Response Type)
07:	00				AA=Normal Response
08:	00		06:	0D	(CBx Response Opcode)
09:	00				0D=Continuous Read Response
10:	00		07:	02	(CBx Response Instance Counter)
11:	00		08:	01	(CBx Response "Node ID")
12:	00		09:	01	(CBx Response Timestamp Month)
13:	00		10:	01	(CBx Response Timestamp Day)
14:	00		11:	02	(CBx Response Timestamp Hour)
15:	00		12:	13	(CBx Response Timestamp Minute)
16:	00		13:	34	(CBx Response Timestamp Second)
17:	00		14:	06	(CBx Response "Data length")
18:	00				6 bytes (the Tag ID)
19:	00		15:	77	(CBx Response Data Byte 1)
20:	00				Tag ID Byte 1
..	..		16:	88	(CBx Response Data Byte 2)
30:	00				Tag ID Byte 2
			17:	99	(CBx Response Data Byte 3)
					Tag ID Byte 3
			18:	AA	(CBx Response Data Byte 4)
					Tag ID Byte 4
			19:	BB	(CBx Response Data Byte 5)
					Tag ID Byte 5
			20:	CC	(CBx Response Data Byte 6)
					Tag ID Byte 6
			..	..	
			30:	00	
31:	81	Data Consistency Byte (OBDCB)	31:	80	Data Consistency Byte (IBDCB)

This response contains a timestamp that is 60 seconds after the previous response, and tag has different data.

Note that the "Instance Counter" in the CBx response increments for each response.

The Master can see that **Bit 0** of the **IBCB & IBDCB** has been toggled, so it knows that a new response in the Input Buffer is ready.

The Master now toggles **Bit 0** of the **OBCB** & **OBDCB** to acknowledge that it has received the response.

(See the **Green** changes below)

Output Buffer			Input Buffer		
Byte #	Value		Byte #	Value	
		Output Buffer Control Byte (OBCB)			Input Buffer Control Byte (ICB)
00:	80	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [0] [0] [0] [0]	00:	80	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [0] [0] [0]
01:	00	(Always 0)	01:	00	(Always 0)
02:	00	(Packet length in bytes)	02:	12	(Packet length in bytes)
03:	00		03:	00	(CBx Response word length MSB)
04:	00		04:	09	(CBx Response word length LSB)
05:	00				Minimum of 6 words
06:	00		05:	AA	(CBx Response Type)
07:	00				AA=Normal Response
08:	00		06:	0D	(CBx Response Opcode)
09:	00				0D=Continuous Read Response
10:	00		07:	02	(CBx Response Instance Counter)
11:	00		08:	01	(CBx Response "Node ID")
12:	00		09:	01	(CBx Response Timestamp Month)
13:	00		10:	01	(CBx Response Timestamp Day)
14:	00		11:	02	(CBx Response Timestamp Hour)
15:	00		12:	13	(CBx Response Timestamp Minute)
16:	00		13:	34	(CBx Response Timestamp Second)
17:	00		14:	06	(CBx Response "Data length")
18:	00				6 bytes (the Tag ID)
19:	00		15:	77	(CBx Response Data Byte 1)
20:	00				Tag ID Byte 1
..	..		16:	88	(CBx Response Data Byte 2)
30:	00				Tag ID Byte 2
			17:	99	(CBx Response Data Byte 3)
					Tag ID Byte 3
			18:	AA	(CBx Response Data Byte 4)
					Tag ID Byte 4
			19:	BB	(CBx Response Data Byte 5)
					Tag ID Byte 5
			20:	CC	(CBx Response Data Byte 6)
					Tag ID Byte 6
			..	..	
			30:	00	
31:	80	Data Consistency Byte (OBDCB)	31:	80	Data Consistency Byte (IBDCB)

No new responses will come from the reader until the Master has acknowledged the previous response by toggling **Bit 0** of the **OBCB** & **OBDCB**.

9.5.3 Example 3: Fragmentation of Responses

For this example, the Master will send a CBx “Read Tag Data” command to the Slave (the RFID Controller) to read 50 bytes from a tag.

We will assume for this example that the both the input and output buffers have been configured to 32 bytes each. This means that the controllers response to the tag read command cannot completely fit in the input buffer, and the response will be “**fragmented**” or sent in multiple fragments.

Sending the command:

In **Byte 2** of the output buffer, the Master places the length (in bytes) of the data packet (CBx Command) we are sending. In this case the CBx command we are sending is 12 bytes. This length is the length of the command bytes we are interested in sending, not the full size of the buffer. The length also does not include the “Data Consistency Byte” at the end of the buffer. That is just a mirror of the Control Byte.

In **Byte 3** through **Byte 14** the Master places the 12 bytes of this particular CBx command. Some CBx commands are larger, but all will be at least 12 bytes, even if some of those 12 bytes are not actually used.

(See the **Green** changes below)

Output Buffer			Input Buffer		
Byte #	Value		Byte #	Value	
		Output Buffer Control Byte (OBCB)			Input Buffer Control Byte (IBCB)
00:	80	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [0] [0] [0]	00:	80	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [0] [0] [0]
01:	00	(Always 0)	01:	00	
02:	0C	(Packet length in bytes)	02:	00	
03:	00	(CBx Command word length MSB)	03:	00	
04:	06	(CBx Command word length LSB) Minimum of 6 words	04:	00	
05:	AA	(CBx Command Type) Always AA	05:	00	
06:	05	(CBx Command Opcode) 0x05 = Read Tag Data	06:	00	
07:	00	(CBx Command, byte not used)	07:	00	
08:	01	(CBx Command “Node ID”)	08:	00	
09:	03	(CBx Command Timeout MSB)	09:	00	
10:	E8	(CBx Command Timeout LSB) 0xE8 = 1000 ms timeout	10:	00	
11:	00	(CBx Command Start Address MSB)	11:	00	
12:	00	(CBx Command Start Address LSB) address 0	12:	00	
13:	00	(CBx Command Length MSB)	13:	00	
14:	32	(CBx Command Length LSB) 50 bytes	14:	00	
15:	00		15:	00	
16:	00		16:	00	
17:	00		17:	00	
18:	00		18:	00	
19:	00		19:	00	
20:	00		20:	00	
..	..		..	..	
30:	00		30:	00	
31:	80	Data Consistency Byte (OBDCB)	31:	80	Data Consistency Byte (IBDCB)

Now that the command is in the Output Buffer, The Master alerts the Slave that the command is ready. It does this by toggling **Bit 1** of the **Output Buffer Control Byte** (the **OBCB**) and then also toggling the same bit in the **Output Buffer Data Consistence Byte** (the **OBDCB**)

**NOTE**

This bit is a toggle. So if it is 0, it is toggled to 1 to indicate a new command. If it is 1, it is toggled to 0 to indicate a new command. If the bit is 1, setting it to 0, and then back to 1 will cause the command to be issued twice.

(See the **Green** changes below)

Output Buffer			Input Buffer		
Byte #	Value		Byte #	Value	
		Output Buffer Control Byte (OBCB)			Input Buffer Control Byte (IBCB)
00:	82	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [0] [1] [0]	00:	80	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [0] [0] [0]
01:	00	(Always 0)	01:	00	
02:	0C	(Packet length in bytes)	02:	00	
03:	00	(CBx Command word length MSB)	03:	00	
04:	06	(CBx Command word length LSB)	04:	00	
		Minimum of 6 words	05:	00	
05:	AA	(CBx Command Type) Always AA	06:	00	
06:	05	(CBx Command Opcode)	07:	00	
		0x05 = Read Tag Data	08:	00	
07:	00	(CBx Command, byte not used)	09:	00	
08:	01	(CBx Command "Node ID")	10:	00	
09:	03	(CBx Command Timeout MSB)	11:	00	
10:	E8	(CBx Command Timeout LSB)	12:	00	
		0xE8 = 1000 ms timeout	13:	00	
11:	00	(CBx Command Start Address MSB)	14:	00	
12:	00	(CBx Command Start Address LSB)	15:	00	
		address 0	16:	00	
13:	00	(CBx Command Length MSB)	17:	00	
14:	32	(CBx Command Length LSB)	18:	00	
		50 bytes	19:	00	
15:	00		20:	00	
16:	00		..	..	
17:	00		30:	00	
18:	00				
19:	00				
20:	00				
..	..				
30:	00				
31:	82	Data Consistency Byte (OBDCB)	31:	80	Data Consistency Byte (IBDCB)

When the Slave sees Bit 1 of the **OBCB & OBDBC** toggle, it grabs the command from the **Output Buffer**. The Slave then acknowledges the command by toggling **Bit 1** of the **Input Buffer Control Byte** (the **IBCB**) and also the same bit of the **Input Buffer Data Consistency Byte** (the **IBDCB**).

(See the **Green** changes below)

Output Buffer			Input Buffer		
Byte #	Value		Byte #	Value	
		Output Buffer Control Byte (OBCB)			Input Buffer Control Byte (IBCB)
00:	82	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [0] [1] [0]	00	82	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [0] [1] [0]
01:	00	(Always 0)	01:	00	
02:	0C	(Packet length in bytes)	02:	00	
03:	00	(CBx Command word length MSB)	03:	00	
04:	06	(CBx Command word length LSB)	04:	00	
		Minimum of 6 words	05:	00	
05:	AA	(CBx Command Type) Always AA	06:	00	
06:	05	(CBx Command Opcode)	07:	00	
		0x05 = Read Tag Data	08:	00	
07:	00	(CBx Command, byte not used)	09:	00	
08:	01	(CBx Command "Node ID")	10:	00	
09:	03	(CBx Command Timeout MSB)	11:	00	
10:	E8	(CBx Command Timeout LSB)	12:	00	
		0xE8 = 1000 ms timeout	13:	00	
11:	00	(CBx Command Start Address MSB)	14:	00	
12:	00	(CBx Command Start Address LSB)	15:	00	
		address 0	16:	00	
13:	00	(CBx Command Length MSB)	17:	00	
14:	32	(CBx Command Length LSB)	18:	00	
		50 bytes	19:	00	
15:	00		20:	00	
16:	00		..	..	
17:	00		30:	00	
18:	00				
19:	00				
20:	00				
..	..				
30:	00				
31:	82	Data Consistency Byte (OBDCB)	31:	82	Data Consistency Byte (IBDCB)

The Slave writes the first fragment of the response into the **Input Buffer**, and toggles **Bit 0** of the **IBCB** to indicate that there is a response fragment ready for the master, and sets **Bit 3** of the **IBCB to 1** to indicate that this is a fragment of a longer response (i.e. there is more data remaining) The Slave also simultaneously makes the same changes to the **IBDCB**.



NOTE

Bit 3 is not a toggle – If it is 1, then there are more fragments to follow. If it is 0, it is either a complete response, or the final fragment of a response.

(See the **Green** changes below)

Output Buffer			Input Buffer		
Byte #	Value		Byte #	Value	
		Output Buffer Control Byte (OBCB)			Input Buffer Control Byte (IBCB)
00:	82	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [0] [1] [0]	00:	8B	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [1] [0] [1] [1]
01:	00	(Always 0)	01:	00	(Always 0)
02:	0C	(Packet length in bytes)	02:	1C	(Packet length in bytes)
03:	00	(CBx Command word length MSB)	03:	00	(CBx Response word length MSB)
04:	06	(CBx Command word length LSB) Minimum of 6 words	04:	1F	(CBx Response word length LSB) Minimum of 6 words
05:	AA	(CBx Command Type) Always AA	05:	AA	(CBx Response Type) AA=Normal Response
06:	05	(CBx Command Opcode) 0x05 = Read Tag Data	06:	05	(CBx Response Opcode) 05=Continuous Read Response
07:	00	(CBx Command, byte not used)	07:	00	(CBx Response Instance Counter)
08:	01	(CBx Command "Node ID")	08:	01	(CBx Response "Node ID")
09:	03	(CBx Command Timeout MSB)	09:	01	(CBx Response Timestamp Month)
10:	E8	(CBx Command Timeout LSB) 0xE8 = 1000 ms timeout	10:	01	(CBx Response Timestamp Day)
11:	00	(CBx Command Start Address MSB)	11:	00	(CBx Response Timestamp Hour)
12:	00	(CBx Command Start Address LSB) address 0	12:	01	(CBx Response Timestamp Minute)
13:	00	(CBx Command Length MSB)	13:	1D	(CBx Response Timestamp Second)
14:	32	(CBx Command Length LSB) 50 bytes	14:	32	(CBx Response "Data length") 50 bytes (total Tag Data)
15:	00		15:	2F	(CBx Response Data Byte 1)
16:	00		16:	13	(CBx Response Data Byte 2)
17:	00		17:	19	(CBx Response Data Byte 3)
18:	00		18:	45	(CBx Response Data Byte 4)
19:	00		19:	94	(CBx Response Data Byte 5)
20:	00		20:	D1	(CBx Response Data Byte 6)
21:	00		21:	B5	(CBx Response Data Byte 7)
22:	00		22:	FA	(CBx Response Data Byte 8)
23:	00		23:	C7	(CBx Response Data Byte 9)
24:	00		24:	42	(CBx Response Data Byte 10)
25:	00		25:	33	(CBx Response Data Byte 11)
26:	00		26:	58	(CBx Response Data Byte 12)
27:	00		27:	A3	(CBx Response Data Byte 13)
28:	00		28:	55	(CBx Response Data Byte 14)
29:	00		29:	88	(CBx Response Data Byte 15)
30:	00		30:	49	(CBx Response Data Byte 16)
31:	82	Data Consistency Byte (OBDCB)	31:	8B	Data Consistency Byte (IBDCB)

The Master can see that **Bit 3** of the **IBCB** & **IBDCB** has been set to 1, so it knows that the response in the **Input Buffer** is just a fragment of a longer response, and not a complete response, and that there are more fragments to follow.

The Master now toggles **Bit 0** of the **OBCB** & **OBDCB** to acknowledge that it has received the response fragment.

(See the **Green** changes below)

Output Buffer			Input Buffer		
Byte #	Value		Byte #	Value	
		Output Buffer Control Byte (OBCB)			Input Buffer Control Byte (IBCB)
00:	83	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [0] [1] [1]	00	8B	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [1] [0] [1]
01:	00	(Always 0)	01:	00	(Always 0)
02:	0C	(Packet length in bytes)	02:	1C	(Packet length in bytes)
03:	00	(CBx Command word length MSB)	03:	00	(CBx Response word length MSB)
04:	06	(CBx Command word length LSB) Minimum of 6 words	04:	1F	(CBx Response word length LSB) Minimum of 6 words
05:	AA	(CBx Command Type) Always AA	05:	AA	(CBx Response Type) AA=Normal Response
06:	05	(CBx Command Opcode) 0x05 = Read Tag Data	06:	05	(CBx Response Opcode) 05=Continuous Read Response
07:	00	(CBx Command, byte not used)	07:	00	(CBx Response Instance Counter)
08:	01	(CBx Command "Node ID")	08:	01	(CBx Response "Node ID")
09:	03	(CBx Command Timeout MSB)	09:	01	(CBx Response Timestamp Month)
10:	E8	(CBx Command Timeout LSB) 0xE8 = 1000 ms timeout	10:	01	(CBx Response Timestamp Day)
11:	00	(CBx Command Start Address MSB)	11:	00	(CBx Response Timestamp Hour)
12:	00	(CBx Command Start Address LSB) address 0	12:	01	(CBx Response Timestamp Minute)
13:	00	(CBx Command Length MSB)	13:	1D	(CBx Response Timestamp Second)
14:	32	(CBx Command Length LSB) 50 bytes	14:	32	(CBx Response "Data length") 50 bytes (total Tag Data)
15:	00		15:	2F	(CBx Response Data Byte 1)
16:	00		16:	13	(CBx Response Data Byte 2)
17:	00		17:	19	(CBx Response Data Byte 3)
18:	00		18:	45	(CBx Response Data Byte 4)
19:	00		19:	94	(CBx Response Data Byte 5)
20:	00		20:	D1	(CBx Response Data Byte 6)
21:	00		21:	B5	(CBx Response Data Byte 7)
22:	00		22:	FA	(CBx Response Data Byte 8)
23:	00		23:	C7	(CBx Response Data Byte 9)
24:	00		24:	42	(CBx Response Data Byte 10)
25:	00		25:	33	(CBx Response Data Byte 11)
26:	00		26:	58	(CBx Response Data Byte 12)
27:	00		27:	A3	(CBx Response Data Byte 13)
28:	00		28:	55	(CBx Response Data Byte 14)
29:	00		29:	88	(CBx Response Data Byte 15)
30:	00		30:	49	(CBx Response Data Byte 16)
31:	83	Data Consistency Byte (OBDCB)	31:	8B	Data Consistency Byte (IBDCB)

After the Master acknowledges that it has received the fragment, the Slave places the next fragment in the Input Buffer and toggles **Bit 0** of the **IBCB** & **IBDCB**.

Since this is still not the last fragment, the Slave leaves **Bit 3** set to 1 in the **IBCB** & **IBDCB**

(See the **Green** changes below)

Output Buffer			Input Buffer		
Byte #	Value		Byte #	Value	
		Output Buffer Control Byte (OBCB)			Input Buffer Control Byte (IBCB)
00:	83	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [0] [1] [1]	00	8A	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [1] [0] [1] [0]
01:	00	(Always 0)	01:	00	(Always 0)
02:	0C	(Packet length in bytes)	02:	1C	(Packet length in bytes)
03:	00	(CBx Command word length MSB)	03:	02	(CBx Response Data Byte 17)
04:	06	(CBx Command word length LSB)	04:	02	(CBx Response Data Byte 18)
05:	AA	(CBx Command Type) Always AA	05:	02	(CBx Response Data Byte 19)
06:	05	(CBx Command Opcode)	06:	02	(CBx Response Data Byte 20)
		0x05 = Read Tag Data	07:	02	(CBx Response Data Byte 21)
07:	00	(CBx Command, byte not used)	08:	02	(CBx Response Data Byte 22)
08:	01	(CBx Command "Node ID")	09:	02	(CBx Response Data Byte 23)
09:	03	(CBx Command Timeout MSB)	10:	02	(CBx Response Data Byte 24)
10:	E8	(CBx Command Timeout LSB)	11:	02	(CBx Response Data Byte 25)
		0xE8 = 1000 ms timeout	12:	02	(CBx Response Data Byte 26)
11:	00	(CBx Command Start Address MSB)	13:	02	(CBx Response Data Byte 27)
12:	00	(CBx Command Start Address LSB)	14:	02	(CBx Response Data Byte 28)
		address 0	15:	02	(CBx Response Data Byte 29)
13:	00	(CBx Command Length MSB)	16:	02	(CBx Response Data Byte 30)
14:	32	(CBx Command Length LSB)	17:	02	(CBx Response Data Byte 31)
		50 bytes	18:	02	(CBx Response Data Byte 32)
15:	00		19:	02	(CBx Response Data Byte 33)
16:	00		20:	02	(CBx Response Data Byte 34)
17:	00		21:	02	(CBx Response Data Byte 35)
18:	00		22:	02	(CBx Response Data Byte 36)
19:	00		23:	02	(CBx Response Data Byte 37)
20:	00		24:	02	(CBx Response Data Byte 38)
..	..		25:	02	(CBx Response Data Byte 39)
30:	00		26:	02	(CBx Response Data Byte 40)
			27:	02	(CBx Response Data Byte 41)
			28:	02	(CBx Response Data Byte 42)
			29:	02	(CBx Response Data Byte 43)
			30:	02	(CBx Response Data Byte 44)
31:	83	Data Consistency Byte (OBDCB)	31:	8A	Data Consistency Byte (IBDCB)

Now the Master acknowledges this fragment by toggling **Bit 0** of the **OBCB** & **OBDCB**. It knows that this is still not the last fragment of the response, since **Bit 3** of the **IBCB** & **IBDCB** is still set to 1.

(See the **Green** changes below)

Output Buffer			Input Buffer		
Byte #	Value		Byte #	Value	
		Output Buffer Control Byte (OBCB)			Input Buffer Control Byte (IBCB)
00:	82	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [0] [1] [0]	00	8A	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [1] [0] [1]
01:	00	(Always 0)	01:	00	(Always 0)
02:	0C	(Packet length in bytes)	02:	1C	(Packet length in bytes)
03:	00	(CBx Command word length MSB)	03:	02	(CBx Response Data Byte 17)
04:	06	(CBx Command word length LSB)	04:	02	(CBx Response Data Byte 18)
		Minimum of 6 words	05:	02	(CBx Response Data Byte 19)
05:	AA	(CBx Command Type) Always AA	06:	02	(CBx Response Data Byte 20)
06:	05	(CBx Command Opcode)	07:	02	(CBx Response Data Byte 21)
		0x05 = Read Tag Data	08:	02	(CBx Response Data Byte 22)
07:	00	(CBx Command, byte not used)	09:	02	(CBx Response Data Byte 23)
08:	01	(CBx Command "Node ID")	10:	02	(CBx Response Data Byte 24)
09:	03	(CBx Command Timeout MSB)	11:	02	(CBx Response Data Byte 25)
10:	E8	(CBx Command Timeout LSB)	12:	02	(CBx Response Data Byte 26)
		0xE8 = 1000 ms timeout	13:	02	(CBx Response Data Byte 27)
11:	00	(CBx Command Start Address MSB)	14:	02	(CBx Response Data Byte 28)
12:	00	(CBx Command Start Address LSB)	15:	02	(CBx Response Data Byte 29)
		address 0	16:	02	(CBx Response Data Byte 30)
13:	00	(CBx Command Length MSB)	17:	02	(CBx Response Data Byte 31)
14:	32	(CBx Command Length LSB)	18:	02	(CBx Response Data Byte 32)
		50 bytes	19:	02	(CBx Response Data Byte 33)
15:	00		20:	02	(CBx Response Data Byte 34)
16:	00		21:	02	(CBx Response Data Byte 35)
17:	00		22:	02	(CBx Response Data Byte 36)
18:	00		23:	02	(CBx Response Data Byte 37)
19:	00		24:	02	(CBx Response Data Byte 38)
20:	00		25:	02	(CBx Response Data Byte 39)
..	..		26:	02	(CBx Response Data Byte 40)
30:	00		27:	02	(CBx Response Data Byte 41)
			28:	02	(CBx Response Data Byte 42)
			29:	02	(CBx Response Data Byte 43)
			30:	02	(CBx Response Data Byte 44)
31:	82	Data Consistency Byte (OBDCB)	31:	8A	Data Consistency Byte (IBDCB)

Now the Slave places the final fragment into the Input Buffer and toggles **Bit 0** of the **IBCB** & **IBDCB** to indicate the new fragment is ready.

Since it is the final fragment, the Slave also now clears **Bit 3** of the **IBCB** & **IBDCB**:

(See the **Green** changes below)

Output Buffer			Input Buffer		
Byte #	Value		Byte #	Value	
		Output Buffer Control Byte (OBCB)			Input Buffer Control Byte (IBCB)
00:	82	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [0] [1] [0]	00	83	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [0] [1] [1]
01:	00	(Always 0)	01:	00	(Always 0)
02:	0C	(Packet length in bytes)	02:	06	(Packet length in bytes)
03:	00	(CBx Command word length MSB)	03:	02	(CBx Response Data Byte 45)
04:	06	(CBx Command word length LSB)	04:	02	(CBx Response Data Byte 46)
		Minimum of 6 words	05:	02	(CBx Response Data Byte 47)
05:	AA	(CBx Command Type) Always AA	06:	02	(CBx Response Data Byte 48)
06:	05	(CBx Command Opcode)	07:	02	(CBx Response Data Byte 49)
		0x05 = Read Tag Data	08:	02	(CBx Response Data Byte 50)
07:	00	(CBx Command, byte not used)	09:	00	
08:	01	(CBx Command "Node ID")	10:	00	
09:	03	(CBx Command Timeout MSB)	11:	00	
10:	E8	(CBx Command Timeout LSB)	12:	00	
		0xE8 = 1000 ms timeout	13:	00	
11:	00	(CBx Command Start Address MSB)	14:	00	
12:	00	(CBx Command Start Address LSB)	15:	00	
		address 0	16:	00	
13:	00	(CBx Command Length MSB)	17:	00	
14:	32	(CBx Command Length LSB)	18:	00	
		50 bytes	19:	00	
15:	00		20:	00	
16:	00		21:	00	
17:	00		22:	00	
18:	00		23:	00	
19:	00		24:	00	
20:	00		25:	00	
..	..		26:	00	
30:	00		27:	00	
			28:	00	
			29:	00	
			30:	00	
31:	82	Data Consistency Byte (OBDCB)	31:	83	Data Consistency Byte (IBDCB)

And lastly, the Master acknowledges receipt of the final fragment by toggling **Bit 0** of its **OBCB & OBDCB**:

(See the **Green** changes below)

Output Buffer			Input Buffer		
Byte #	Value		Byte #	Value	
		Output Buffer Control Byte (OBCB)			Input Buffer Control Byte (IBCB)
00:	83	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [0] [1] [1]	00:	83	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [0] [1] [1]
01:	00	(Always 0)	01:	00	(Always 0)
02:	0C	(Packet length in bytes)	02:	06	(Packet length in bytes)
03:	00	(CBx Command word length MSB)	03:	02	(CBx Response Data Byte 45)
04:	06	(CBx Command word length LSB)	04:	02	(CBx Response Data Byte 46)
		Minimum of 6 words	05:	02	(CBx Response Data Byte 47)
05:	AA	(CBx Command Type) Always AA	06:	02	(CBx Response Data Byte 48)
06:	05	(CBx Command Opcode)	07:	02	(CBx Response Data Byte 49)
		0x05 = Read Tag Data	08:	02	(CBx Response Data Byte 50)
07:	00	(CBx Command, byte not used)	09:	00	
08:	01	(CBx Command "Node ID")	10:	00	
09:	03	(CBx Command Timeout MSB)	11:	00	
10:	E8	(CBx Command Timeout LSB)	12:	00	
		0xE8 = 1000 ms timeout	13:	00	
11:	00	(CBx Command Start Address MSB)	14:	00	
12:	00	(CBx Command Start Address LSB)	15:	00	
		address 0	16:	00	
13:	00	(CBx Command Length MSB)	17:	00	
14:	32	(CBx Command Length LSB)	18:	00	
		50 bytes	19:	00	
15:	00		20:	00	
16:	00		21:	00	
17:	00		22:	00	
18:	00		23:	00	
19:	00		24:	00	
20:	00		25:	00	
..	..		26:	00	
30:	00		27:	00	
			28:	00	
			29:	00	
			30:	00	
31:	83	Data Consistency Byte (OBDCB)	31:	83	Data Consistency Byte (IBDCB)

The command/response sequence has completed. A command has been issued and the response received and all fragments of a response have been retrieved and acknowledged.

9.5.4 Example 4: Fragmentation of Commands

For this example, the Master will send a CBx “Write Tag Data” command to the Slave (the RFID Controller) to write 50 bytes to a tag.

We will assume for this example that the both the input and output buffers have been configured to 32 bytes each. This means that the command itself cannot completely fit in the output buffer, and therefore needs to be sent in fragments. Long Tag writes that exceed the buffer size can be separated into multiple writes, with each write addressed to a different location of the tag, but if it is desirable to send one long CBx command, it can be accomplished using this method of fragmentation:

Sending the command:

In **Byte 2** of the output buffer the Master places the length (in bytes) of the data packet (first Fragment of the CBx Command) we are sending – in this case the first fragment will be 28 bytes – the maximum size of a packet when the output buffer is 32 bytes.

(The entire CBx command we are planning to send, over 3 fragments, is 62 bytes).

In **Byte 3** through **Byte 30** the Master places the first 28 bytes of this CBx command.

(See the **Green** changes below)

Output Buffer			Input Buffer		
Byte #	Value		Byte #	Value	
		Output Buffer Control Byte (OBCB)			Input Buffer Control Byte (IBCB)
00:	80	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [0] [0] [0]	00	80	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [0] [0] [0]
01:	00	(Always 0)	01:	00	
02:	1C	(Packet length in bytes)	02:	00	
03:	00	(CBx Command word length MSB)	03:	00	
04:	1F	(CBx Command word length LSB)	04:	00	
05:	AA	(CBx Command Type) Always AA	05:	00	
06:	06	(CBx Command Opcode) 0x06 = Write Tag Data	06:	00	
07:	00	(CBx Command, byte not used)	07:	00	
08:	01	(CBx Command “Node ID”)	08:	00	
09:	03	(CBx Command Timeout MSB)	09:	00	
10:	E8	(CBx Command Timeout LSB) 0xE8 = 1000 ms timeout	10:	00	
11:	00	(CBx Command Start Address MSB)	11:	00	
12:	00	(CBx Command Start Address LSB) address 0	12:	00	
13:	00	(CBx Command Length MSB)	13:	00	
14:	32	(CBx Command Length LSB) 50 bytes	14:	00	
15:	41	(CBx Command Data Byte 1)	15:	00	
16:	42	(CBx Command Data Byte 2)	16:	00	
17:	43	(CBx Command Data Byte 3)	17:	00	
18:	44	(CBx Command Data Byte 4)	18:	00	
19:	45	(CBx Command Data Byte 5)	19:	00	
20:	46	(CBx Command Data Byte 6)	20:	00	
21:	47	(CBx Command Data Byte 7)	..	..	
22:	48	(CBx Command Data Byte 8)	30:	00	
23:	49	(CBx Command Data Byte 9)			
24:	50	(CBx Command Data Byte 10)			
25:	51	(CBx Command Data Byte 11)			
26:	52	(CBx Command Data Byte 12)			
27:	53	(CBx Command Data Byte 13)			
28:	54	(CBx Command Data Byte 14)			
29:	55	(CBx Command Data Byte 15)			
30:	56	(CBx Command Data Byte 16)			
31:	80	Data Consistency Byte (OBDCB)	31:	80	Data Consistency Byte (IBDCB)

Now that the first command fragment is in the Output Buffer, the Master alerts the Slave that the command fragment is ready. It does this by toggling **Bit 1** of the **OBCB & OBDCB**.

Since there are more command fragments to follow to complete the command, the Master also sets **Bit 3** of the **OBCB & OBDCB** to 1. This bit is what tells the Slave to wait for further fragments before processing the command.

(See the **Green** changes below)

Output Buffer			Input Buffer		
Byte #	Value		Byte #	Value	
		Output Buffer Control Byte (OBCB)			Input Buffer Control Byte (IBCB)
00:	8A	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [1] [0] [1] [0]	00	80	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [0] [0] [0]
01:	00	(Always 0)	01:	00	
02:	1C	(Packet length in bytes)	02:	00	
03:	00	(CBx Command word length MSB)	03:	00	
04:	1F	(CBx Command word length LSB)	04:	00	
05:	AA	(CBx Command Type) Always AA	05:	00	
06:	06	(CBx Command Opcode) 0x06 = Write Tag Data	06:	00	
07:	00	(CBx Command, byte not used)	07:	00	
08:	01	(CBx Command "Node ID")	08:	00	
09:	03	(CBx Command Timeout MSB)	09:	00	
10:	E8	(CBx Command Timeout LSB) 0xE8 = 1000 ms timeout	10:	00	
11:	00	(CBx Command Start Address MSB)	11:	00	
12:	00	(CBx Command Start Address LSB) address 0	12:	00	
13:	00	(CBx Command Length MSB)	13:	00	
14:	32	(CBx Command Length LSB) 50 bytes	14:	00	
15:	41	(CBx Command Data Byte 1)	15:	00	
16:	42	(CBx Command Data Byte 2)	16:	00	
17:	43	(CBx Command Data Byte 3)	17:	00	
18:	44	(CBx Command Data Byte 4)	18:	00	
19:	45	(CBx Command Data Byte 5)	19:	00	
20:	46	(CBx Command Data Byte 6)	20:	00	
21:	47	(CBx Command Data Byte 7)	..	..	
22:	48	(CBx Command Data Byte 8)	30:	00	
23:	49	(CBx Command Data Byte 9)			
24:	50	(CBx Command Data Byte 10)			
25:	51	(CBx Command Data Byte 11)			
26:	52	(CBx Command Data Byte 12)			
27:	53	(CBx Command Data Byte 13)			
28:	54	(CBx Command Data Byte 14)			
29:	55	(CBx Command Data Byte 15)			
30:	56	(CBx Command Data Byte 16)			
31:	8A	Data Consistency Byte (OBDCB)	31:	80	Data Consistency Byte (IBDCB)

When the Slave sees Bit 1 of the **OBCB** & **OBDBC** toggle, it grabs the command fragment from the **Output Buffer**. The Slave then acknowledges the command fragment by toggling **Bit 1** of the **IBCB** & **IBDCB**.

(See the **Green** changes below)

Output Buffer			Input Buffer		
Byte #	Value		Byte #	Value	
		Output Buffer Control Byte (OBCB)			Input Buffer Control Byte (IBCB)
00:	8A	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [1] [0] [1] [0]	00	82	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [0] [1] [0]
01:	00	(Always 0)	01:	00	
02:	1C	(Packet length in bytes)	02:	00	
03:	00	(CBx Command word length MSB)	03:	00	
04:	1F	(CBx Command word length LSB)	04:	00	
05:	AA	(CBx Command Type) Always AA	05:	00	
06:	06	(CBx Command Opcode) 0x06 = Write Tag Data	06:	00	
07:	00	(CBx Command, byte not used)	07:	00	
08:	01	(CBx Command "Node ID")	08:	00	
09:	03	(CBx Command Timeout MSB)	09:	00	
10:	E8	(CBx Command Timeout LSB) 0xE8 = 1000 ms timeout	10:	00	
11:	00	(CBx Command Start Address MSB)	11:	00	
12:	00	(CBx Command Start Address LSB) address 0	12:	00	
13:	00	(CBx Command Length MSB)	13:	00	
14:	32	(CBx Command Length LSB) 50 bytes	14:	00	
15:	41	(CBx Command Data Byte 1)	15:	00	
16:	42	(CBx Command Data Byte 2)	16:	00	
17:	43	(CBx Command Data Byte 3)	17:	00	
18:	44	(CBx Command Data Byte 4)	18:	00	
19:	45	(CBx Command Data Byte 5)	19:	00	
20:	46	(CBx Command Data Byte 6)	20:	00	
21:	47	(CBx Command Data Byte 7)	..	..	
22:	48	(CBx Command Data Byte 8)	30:	00	
23:	49	(CBx Command Data Byte 9)			
24:	50	(CBx Command Data Byte 10)			
25:	51	(CBx Command Data Byte 11)			
26:	52	(CBx Command Data Byte 12)			
27:	53	(CBx Command Data Byte 13)			
28:	54	(CBx Command Data Byte 14)			
29:	55	(CBx Command Data Byte 15)			
30:	56	(CBx Command Data Byte 16)			
31:	8A	Data Consistency Byte (OBDCB)	31:	82	Data Consistency Byte (IBDCB)

Now that the Slave has acknowledged receiving the command fragment, the Master writes the next command fragment into the Output Buffer:

(See the **Green** changes below)

Output Buffer			Input Buffer		
Byte #	Value		Byte #	Value	
		Output Buffer Control Byte (OBCB)			Input Buffer Control Byte (IBCB)
00:	8A	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [1] [0] [1] [0]	00	82	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [0] [1] [0]
01:	00	(Always 0)	01:	00	
02:	1C	(Packet length in bytes)	02:	00	
03:	57	(CBx Command Data Byte 17)	03:	00	
04:	58	(CBx Command Data Byte 18)	04:	00	
05:	59	(CBx Command Data Byte 19)	05:	00	
06:	60	(CBx Command Data Byte 20)	06:	00	
07:	61	(CBx Command Data Byte 21)	07:	00	
08:	62	(CBx Command Data Byte 22)	08:	00	
09:	63	(CBx Command Data Byte 23)	09:	00	
10:	64	(CBx Command Data Byte 24)	10:	00	
11:	65	(CBx Command Data Byte 25)	11:	00	
12:	66	(CBx Command Data Byte 26)	12:	00	
13:	67	(CBx Command Data Byte 27)	13:	00	
14:	68	(CBx Command Data Byte 28)	14:	00	
15:	69	(CBx Command Data Byte 29)	15:	00	
16:	70	(CBx Command Data Byte 30)	16:	00	
17:	71	(CBx Command Data Byte 31)	17:	00	
18:	72	(CBx Command Data Byte 32)	18:	00	
19:	73	(CBx Command Data Byte 33)	19:	00	
20:	74	(CBx Command Data Byte 34)	20:	00	
21:	75	(CBx Command Data Byte 35)	..	..	
22:	76	(CBx Command Data Byte 36)	30:	00	
23:	77	(CBx Command Data Byte 37)			
24:	78	(CBx Command Data Byte 38)			
25:	79	(CBx Command Data Byte 39)			
26:	80	(CBx Command Data Byte 40)			
27:	81	(CBx Command Data Byte 41)			
28:	82	(CBx Command Data Byte 42)			
29:	83	(CBx Command Data Byte 43)			
30:	84	(CBx Command Data Byte 44)			
31:	8A	Data Consistency Byte (OBDCB)	31:	82	Data Consistency Byte (IBDCB)

Next, the Master signals that this fragment is ready, by toggling **Bit 1** of the **OBCB** & **OBDCB**. Since this is still not the final fragment, the Master leaves **Bit 3** set to 1.

(See the **Green** changes below)

Output Buffer			Input Buffer		
Byte #	Value		Byte #	Value	
		Output Buffer Control Byte (OBCB)			Input Buffer Control Byte (IBCB)
00:	88	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [1] [0] [0] [0]	00:	82	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [0] [1] [0]
01:	00	(Always 0)	01:	00	
02:	1C	(Packet length in bytes)	02:	00	
03:	57	(CBx Command Data Byte 17)	03:	00	
04:	58	(CBx Command Data Byte 18)	04:	00	
05:	59	(CBx Command Data Byte 19)	05:	00	
06:	60	(CBx Command Data Byte 20)	06:	00	
07:	61	(CBx Command Data Byte 21)	07:	00	
08:	62	(CBx Command Data Byte 22)	08:	00	
09:	63	(CBx Command Data Byte 23)	09:	00	
10:	64	(CBx Command Data Byte 24)	10:	00	
11:	65	(CBx Command Data Byte 25)	11:	00	
12:	66	(CBx Command Data Byte 26)	12:	00	
13:	67	(CBx Command Data Byte 27)	13:	00	
14:	68	(CBx Command Data Byte 28)	14:	00	
15:	69	(CBx Command Data Byte 29)	15:	00	
16:	70	(CBx Command Data Byte 30)	16:	00	
17:	71	(CBx Command Data Byte 31)	17:	00	
18:	72	(CBx Command Data Byte 32)	18:	00	
19:	73	(CBx Command Data Byte 33)	19:	00	
20:	74	(CBx Command Data Byte 34)	20:	00	
21:	75	(CBx Command Data Byte 35)	..	..	
22:	76	(CBx Command Data Byte 36)	30:	00	
23:	77	(CBx Command Data Byte 37)			
24:	78	(CBx Command Data Byte 38)			
25:	79	(CBx Command Data Byte 39)			
26:	80	(CBx Command Data Byte 40)			
27:	81	(CBx Command Data Byte 41)			
28:	82	(CBx Command Data Byte 42)			
29:	83	(CBx Command Data Byte 43)			
30:	84	(CBx Command Data Byte 44)			
31:	88	Data Consistency Byte (OBDCB)	31:	82	Data Consistency Byte (IBDCB)

When the Slave sees Bit 1 of the **OBCB** & **OBDBC** toggle, it grabs this command fragment from the Output Buffer. The Slave then acknowledges the command fragment by toggling **Bit 1** of the **IBCB** & **IBDCB**.

(See the **Green** changes below)

Output Buffer			Input Buffer		
Byte #	Value		Byte #	Value	
		Output Buffer Control Byte (OBCB)			Input Buffer Control Byte (IBCB)
00:	88	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [1] [0] [0] [0]	00	80	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [0] [0] [0] [0]
01:	00	(Always 0)	01:	00	
02:	1C	(Packet length in bytes)	02:	00	
03:	57	(CBx Command Data Byte 17)	03:	00	
04:	58	(CBx Command Data Byte 18)	04:	00	
05:	59	(CBx Command Data Byte 19)	05:	00	
06:	60	(CBx Command Data Byte 20)	06:	00	
07:	61	(CBx Command Data Byte 21)	07:	00	
08:	62	(CBx Command Data Byte 22)	08:	00	
09:	63	(CBx Command Data Byte 23)	09:	00	
10:	64	(CBx Command Data Byte 24)	10:	00	
11:	65	(CBx Command Data Byte 25)	11:	00	
12:	66	(CBx Command Data Byte 26)	12:	00	
13:	67	(CBx Command Data Byte 27)	13:	00	
14:	68	(CBx Command Data Byte 28)	14:	00	
15:	69	(CBx Command Data Byte 29)	15:	00	
16:	70	(CBx Command Data Byte 30)	16:	00	
17:	71	(CBx Command Data Byte 31)	17:	00	
18:	72	(CBx Command Data Byte 32)	18:	00	
19:	73	(CBx Command Data Byte 33)	19:	00	
20:	74	(CBx Command Data Byte 34)	20:	00	
21:	75	(CBx Command Data Byte 35)	..	..	
22:	76	(CBx Command Data Byte 36)	30:	00	
23:	77	(CBx Command Data Byte 37)			
24:	78	(CBx Command Data Byte 38)			
25:	79	(CBx Command Data Byte 39)			
26:	80	(CBx Command Data Byte 40)			
27:	81	(CBx Command Data Byte 41)			
28:	82	(CBx Command Data Byte 42)			
29:	83	(CBx Command Data Byte 43)			
30:	84	(CBx Command Data Byte 44)			
31:	88	Data Consistency Byte (OBDCB)	31:	80	Data Consistency Byte (IBDCB)

Now that the Slave has acknowledged receiving the command fragment, the Master writes the next (and final) command fragment into the Output Buffer:

(See the **Green** changes below)

Output Buffer			Input Buffer		
Byte #	Value		Byte #	Value	
		Output Buffer Control Byte (OBCB)			Input Buffer Control Byte (IBCB)
00:	88	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [1] [0] [0] [0]	00	80	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [0] [0] [0]
01:	00	(Always 0)	01:	00	
02:	06	(Packet length in bytes)	02:	00	
03:	85	(CBx Command Data Byte 45)	03:	00	
04:	86	(CBx Command Data Byte 46)	04:	00	
05:	87	(CBx Command Data Byte 47)	05:	00	
06:	88	(CBx Command Data Byte 48)	06:	00	
07:	89	(CBx Command Data Byte 49)	07:	00	
08:	90	(CBx Command Data Byte 50)	08:	00	
09:	00		09:	00	
10:	00		10:	00	
11:	00		11:	00	
12:	00		12:	00	
13:	00		13:	00	
14:	00		14:	00	
15:	00		15:	00	
16:	00		16:	00	
17:	00		17:	00	
18:	00		18:	00	
19:	00		19:	00	
20:	00		20:	00	
21:	00		..	..	
22:	00		30:	00	
23:	00				
24:	00				
25:	00				
26:	00				
27:	00				
28:	00				
29:	00				
30:	00				
31:	88	Data Consistency Byte (OBDCB)	31:	80	Data Consistency Byte (IBDCB)

Next, the Master signals that this fragment is ready, by toggling **Bit 1** of the **OBCB** & **OBDCB**. Since this **is** the final fragment, the Master clears **Bit 3** to 0.

(See the **Green** changes below)

Output Buffer			Input Buffer		
Byte #	Value		Byte #	Value	
		Output Buffer Control Byte (OBCB)			Input Buffer Control Byte (IBCB)
00:	82	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [0] [1] [0]	00:	80	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [0] [0] [0]
01:	00	(Always 0)	01:	00	
02:	06	(Packet length in bytes)	02:	00	
03:	85	(CBx Command Data Byte 45)	03:	00	
04:	86	(CBx Command Data Byte 46)	04:	00	
05:	87	(CBx Command Data Byte 47)	05:	00	
06:	88	(CBx Command Data Byte 48)	06:	00	
07:	89	(CBx Command Data Byte 49)	07:	00	
08:	90	(CBx Command Data Byte 50)	08:	00	
09:	00		09:	00	
10:	00		10:	00	
11:	00		11:	00	
12:	00		12:	00	
13:	00		13:	00	
14:	00		14:	00	
15:	00		15:	00	
16:	00		16:	00	
17:	00		17:	00	
18:	00		18:	00	
19:	00		19:	00	
20:	00		20:	00	
21:	00		..	..	
22:	00		30:	00	
23:	00				
24:	00				
25:	00				
26:	00				
27:	00				
28:	00				
29:	00				
30:	00				
31:	82	Data Consistency Byte (OBDCB)	31:	80	Data Consistency Byte (IBDCB)

When the Slave sees Bit 1 of the **OBCB** & **OBDBC** toggle, it grabs this command fragment from the Output Buffer. The Slave then acknowledges the command fragment by toggling **Bit 1** of the **IBCB** & **IBDCB**.

(See the **Green** changes below)

Output Buffer			Input Buffer		
Byte #	Value		Byte #	Value	
		Output Buffer Control Byte (OBCB)			Input Buffer Control Byte (IBCB)
00:	82	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [0] [1] [0]	00	82	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [0] [0] [1] [0]
01:	00	(Always 0)	01:	00	
02:	06	(Packet length in bytes)	02:	00	
03:	85	(CBx Command Data Byte 45)	03:	00	
04:	86	(CBx Command Data Byte 46)	04:	00	
05:	87	(CBx Command Data Byte 47)	05:	00	
06:	88	(CBx Command Data Byte 48)	06:	00	
07:	89	(CBx Command Data Byte 49)	07:	00	
08:	90	(CBx Command Data Byte 50)	08:	00	
09:	00		09:	00	
10:	00		10:	00	
11:	00		11:	00	
12:	00		12:	00	
13:	00		13:	00	
14:	00		14:	00	
15:	00		15:	00	
16:	00		16:	00	
17:	00		17:	00	
18:	00		18:	00	
19:	00		19:	00	
20:	00		20:	00	
21:	00		..	..	
22:	00		30:	00	
23:	00				
24:	00				
25:	00				
26:	00				
27:	00				
28:	00				
29:	00				
30:	00				
31:	82	Data Consistency Byte (OBDCB)	31:	82	Data Consistency Byte (IBDCB)

The Slave, at this point, after acknowledging the final fragment, knows it has the complete CBx command, so it processes the command.

Assuming the command is successful, the Slave will write the response (in this case a "Tag Write Successful" response) into the Input buffer, and then toggle **Bit 0** of the **IBCB** & **IBDCB**.

(See the **Green** changes below)

Output Buffer			Input Buffer		
Byte #	Value		Byte #	Value	
		Output Buffer Control Byte (OBCB)			Input Buffer Control Byte (IBCB)
00:	82	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [0] [1] [0]	00	83	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [0] [1] [1]
01:	00	(Always 0)	01:	00	
02:	06	(Packet length in bytes)	02:	0C	(Packet length in bytes)
03:	85	(CBx Command Data Byte 45)	03:	00	(CBx Response word length MSB)
04:	86	(CBx Command Data Byte 46)	04:	06	(CBx Response word length LSB)
05:	87	(CBx Command Data Byte 47)			Minimum of 6 words
06:	88	(CBx Command Data Byte 48)	05:	AA	(CBx Response Type)
07:	89	(CBx Command Data Byte 49)			AA=Normal Response
08:	90	(CBx Command Data Byte 50)	06:	06	(CBx Response Opcode)
09:	00				06=echo of "Tag Write"
10:	00		07:	01	(CBx Response Instance Counter)
11:	00		08:	01	(CBx Response "Node ID")
12:	00		09:	01	(CBx Response Timestamp Month)
13:	00		10:	01	(CBx Response Timestamp Day)
14:	00		11:	00	(CBx Response Timestamp Hour)
15:	00		12:	01	(CBx Response Timestamp Minute)
16:	00		13:	20	(CBx Response Timestamp Second)
17:	00		14:	00	(CBx Response Not Used)
18:	00		15:	00	
19:	00		16:	00	
20:	00		17:	00	
21:	00		18:	00	
22:	00		19:	00	
23:	00		20:	00	
24:	00		..	..	
25:	00		30:	00	
26:	00				
27:	00				
28:	00				
29:	00				
30:	00				
31:	82	Data Consistency Byte (OBDCB)	31:	83	Data Consistency Byte (IBDCB)

The Master now toggles **Bit 0** of the **OBCB** & **OBDCB** to acknowledge that it has received the response.

(See the **Green** changes below)

Output Buffer			Input Buffer		
Byte #	Value		Byte #	Value	
		Output Buffer Control Byte (OBCB)			Input Buffer Control Byte (IBCB)
00:	83	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [0] [1] [1]	00:	83	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [0] [1] [1]
01:	00	(Always 0)	01:	00	
02:	06	(Packet length in bytes)	02:	0C	(Packet length in bytes)
03:	85	(CBx Command Data Byte 45)	03:	00	(CBx Response word length MSB)
04:	86	(CBx Command Data Byte 46)	04:	06	(CBx Response word length LSB) Minimum of 6 words
05:	87	(CBx Command Data Byte 47)	05:	AA	(CBx Response Type) AA=Normal Response
06:	88	(CBx Command Data Byte 48)	06:	06	(CBx Response Opcode) 06=echo of "Tag Write"
07:	89	(CBx Command Data Byte 49)	07:	01	(CBx Response Instance Counter)
08:	90	(CBx Command Data Byte 50)	08:	01	(CBx Response "Node ID")
09:	00		09:	01	(CBx Response Timestamp Month)
10:	00		10:	01	(CBx Response Timestamp Day)
11:	00		11:	00	(CBx Response Timestamp Hour)
12:	00		12:	01	(CBx Response Timestamp Minute)
13:	00		13:	20	(CBx Response Timestamp Second)
14:	00		14:	00	(CBx Response Not Used)
15:	00		15:	00	
16:	00		16:	00	
17:	00		17:	00	
18:	00		18:	00	
19:	00		19:	00	
20:	00		20:	00	
21:	00		..	..	
22:	00		30:	00	
23:	00				
24:	00				
25:	00				
26:	00				
27:	00				
28:	00				
29:	00				
30:	00				
31:	83	Data Consistency Byte (OBDCB)	31:	83	Data Consistency Byte (IBDCB)

The command/response sequence has completed. A command has been issued over 3 fragments and processed, and the response received and the response has been acknowledged.

9.5.5 Example 5: Resynchronization

For this example we will assume the same conditions as the previous example, that the input buffer and output buffer are 32 bytes each.

It does not matter what data is currently in the two buffers, other than the control bytes and data consistency bytes – resynchronization only resets the handshaking to a known state.

For this example we will assume a starting state as follows:

Output Buffer			Input Buffer		
Byte #	Value		Byte #	Value	
		Output Buffer Control Byte (OBCB)			Input Buffer Control Byte (IBCB)
00:	80	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [0] [0] [0]	00:	82	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [0] [1] [0]
01:	00	(Always 0)	01:	00	
02:	06	(Packet length in bytes)	02:	00	
03:	00		03:	00	
04:	00		04:	00	
05:	00		05:	00	
06:	00		06:	00	
07:	00		07:	00	
08:	00		08:	00	
09:	00		09:	00	
10:	00		10:	00	
11:	00		11:	00	
12:	00		12:	00	
13:	00		13:	00	
14:	00		14:	00	
15:	00		15:	00	
16:	00		16:	00	
17:	00		17:	00	
18:	00		18:	00	
19:	00		19:	00	
20:	00		20:	00	
..			..		
30:			30:	00	
31:	80	Data Consistency Byte (OBDCB)	31:	82	Data Consistency Byte (IBDCB)

If the Master believes that the handshaking has gotten out of synch, it can request a resynchronization, by setting **Bit 2** of the **Output Buffer Control Byte** (the **OBCB**) and then also setting the same bit in the **Output Buffer Data Consistency Byte** (the **OBDCB**).

**NOTE**

Bit 2 is not a toggle – It is always set to 1 to begin a resynchronization process, and cleared later to acknowledge that the process is complete.

(See the **Green** changes below)

Output Buffer			Input Buffer		
Byte #	Value		Byte #	Value	
		Output Buffer Control Byte (OBCB)			Input Buffer Control Byte (IBCB)
00:	84	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [1] [0] [0]	00	82	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [0] [1] [0]
01:	00	(Always 0)	01:	00	
02:	06	(Packet length in bytes)	02:	00	
03:	00		03:	00	
04:	00		04:	00	
05:	00		05:	00	
06:	00		06:	00	
07:	00		07:	00	
08:	00		08:	00	
09:	00		09:	00	
10:	00		10:	00	
11:	00		11:	00	
12:	00		12:	00	
13:	00		13:	00	
14:	00		14:	00	
15:	00		15:	00	
16:	00		16:	00	
17:	00		17:	00	
18:	00		18:	00	
19:	00		19:	00	
20:	00		20:	00	
..			..		
30:			30:	00	
31:	84	Data Consistency Byte (OBDCB)	31:	82	Data Consistency Byte (IBDCB)

When the slave sees **Bit 2** In the **OBCB** & **OBDCB** set, it knows it needs to resynchronize its handshaking bits in the **IBCB** & **IBDCB**.

So the Slave will acknowledge the resynchronization request by setting **Bit 2**, and will clear **Bit 1** and **Bit 0** in the **IBCB** & **IBDCB**.

Note that whatever values Bit 1 or Bit 0 had, they will be set to 0. This process forces the handshaking into a known state.

(See the **Green** changes below)

Output Buffer			Input Buffer		
Byte #	Value		Byte #	Value	
		Output Buffer Control Byte (OBCB)			Input Buffer Control Byte (IBCB)
00:	84	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [1] [0] [0]	00:	84	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [1] [0] [0]
01:	00	(Always 0)	01:	00	
02:	06	(Packet length in bytes)	02:	00	
03:	00		03:	00	
04:	00		04:	00	
05:	00		05:	00	
06:	00		06:	00	
07:	00		07:	00	
08:	00		08:	00	
09:	00		09:	00	
10:	00		10:	00	
11:	00		11:	00	
12:	00		12:	00	
13:	00		13:	00	
14:	00		14:	00	
15:	00		15:	00	
16:	00		16:	00	
17:	00		17:	00	
18:	00		18:	00	
19:	00		19:	00	
20:	00		20:	00	
..			..		
30:			30:	00	
31:	84	Data Consistency Byte (OBDCB)	31:	84	Data Consistency Byte (IBDCB)

When the Master sees **Bit 2** of the **IBCB** & **IBDCB** set, it clears **Bit 2** of the **OBCB** & **OBDCB** to acknowledge that the Slave has resynchronized.

(See the **Green** changes below)

Output Buffer			Input Buffer		
Byte #	Value		Byte #	Value	
		Output Buffer Control Byte (OBCB)			Input Buffer Control Byte (IBCB)
00:	80	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [0] [0] [0]	00	84	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [0] [1] [0]
01:	00	(Always 0)	01:	00	
02:	06	(Packet length in bytes)	02:	00	
03:	00		03:	00	
04:	00		04:	00	
05:	00		05:	00	
06:	00		06:	00	
07:	00		07:	00	
08:	00		08:	00	
09:	00		09:	00	
10:	00		10:	00	
11:	00		11:	00	
12:	00		12:	00	
13:	00		13:	00	
14:	00		14:	00	
15:	00		15:	00	
16:	00		16:	00	
17:	00		17:	00	
18:	00		18:	00	
19:	00		19:	00	
20:	00		20:	00	
..			..		
30:			30:	00	
31:	80	Data Consistency Byte (OBDCB)	31:	84	Data Consistency Byte (IBDCB)

And lastly, when the Slave sees the Master clear **Bit 2** of the **OBCD** & **OBCDB**, it clears **Bit 2** of the **IBCB** & **IBDCB** to complete the resynchronization process.

(See the **Green** changes below)

Output Buffer			Input Buffer		
Byte #	Value		Byte #	Value	
		Output Buffer Control Byte (OBCB)			Input Buffer Control Byte (IBCB)
00:	80	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [0] [0] [0]	00:	80	7 6 5 4 3 2 1 0 [1] [0] [0] [0] [0] [0] [0] [0]
01:	00	(Always 0)	01:	00	
02:	06	(Packet length in bytes)	02:	00	
03:	00		03:	00	
04:	00		04:	00	
05:	00		05:	00	
06:	00		06:	00	
07:	00		07:	00	
08:	00		08:	00	
09:	00		09:	00	
10:	00		10:	00	
11:	00		11:	00	
12:	00		12:	00	
13:	00		13:	00	
14:	00		14:	00	
15:	00		15:	00	
16:	00		16:	00	
17:	00		17:	00	
18:	00		18:	00	
19:	00		19:	00	
20:	00		20:	00	
..			..		
30:			30:	00	
31:	80	Data Consistency Byte (OBDCB)	31:	80	Data Consistency Byte (IBDCB)

The Resynchronization process is complete. The Slave is now in a known state, with the handshake bits set to zero, and internally in a state of “waiting for a new command”.

10 PROFINET INTERFACE



For Cobalt HF-CNTL-PNT-02 models.

NOTE

10.1 PROFINET OVERVIEW

Profinet is the open industrial Ethernet standard of PROFIBUS & PROFINET International (PI) for automation. Profinet uses TCP/IP and IT standards, and is, in effect, real-time Ethernet. The Profinet concept features a modular structure so that users can select the cascading functions themselves. They differ essentially because of the type of data exchange to fulfill the partly very high requirements of speed. Profinet is defined by PROFIBUS & PROFINET International (PI) and backed by the INTERBUS Club and, since 2003, is part of the IEC 61158 and IEC 61784 standards.

10.2 PROFINET IO

In conjunction with PROFINET, the two perspectives PROFINET CBA and PROFINET IO exist.

PROFINET CBA

Suitable for component-based communication via TCP/IP and real-time communication for real-time requirements in modular systems engineering.

PROFINET IO

Developed for real time (RT) and isochronous real time (IRT) communication with decentral periphery. The designations RT and IRT merely describe the real-time properties for the communication within PROFINET IO.

The Profinet Controller supports **Profinet IO**:

MAIN FEATURES:

- Complies to conformance class B
- Device characteristics stored in a .GSD file, used by PROFINET engineering tools when setting up the network configuration.
- 100Mbps, full duplex with auto-negotiation enabled as default
- Up to 248 bytes of IO Data

10.3 DATA EXCHANGE

The Master Profinet is usually a PLC (Siemens S7 or others) but it could be a PC based device as well. The Profinet Controller is always Slave in the Profinet network.

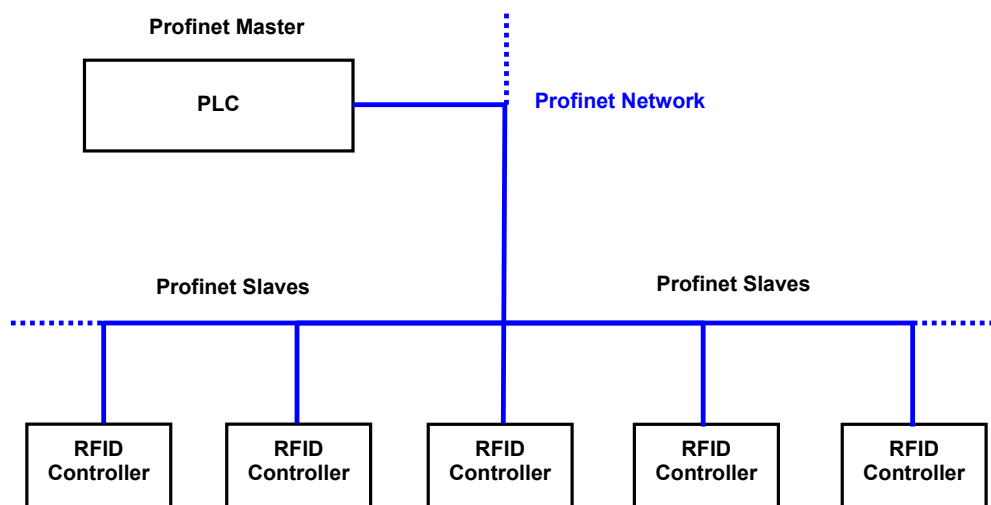


Figure 73 - Profinet IO Network Diagram

Basically two shared memory areas (Exchange Areas) are used to exchange information between the SLAVE and the MASTER, both devices provide information to each other.

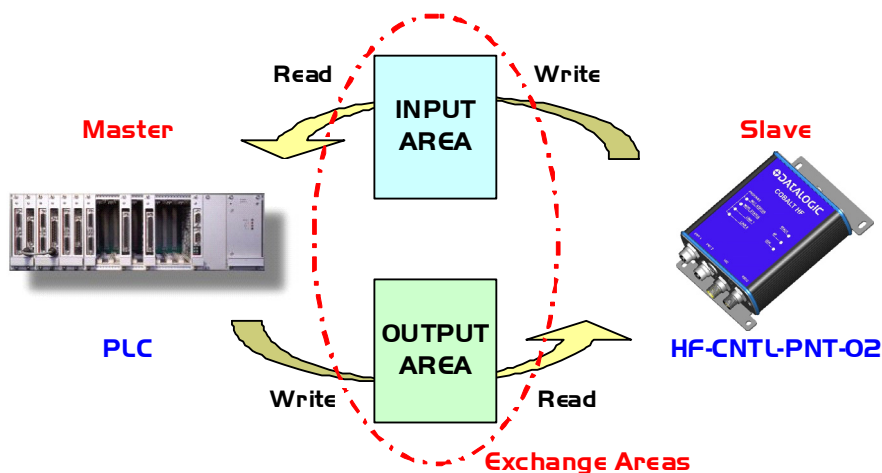


Figure 74 - Profinet Communication – Data Exchange Areas Diagram

Input and Output areas always refer to the Master: this means that the Controller writes to the Input buffer and the PLC writes to the Output buffer.

The dimension of the exchange areas can be set to different values by the PLC through the GSD file: the Profinet Controller allows up to **248 bytes as a combined total of the Input and Output Areas**.



NOTE

For further information regarding Fieldbus interfacing including downloadable support files, go to the HMS website at <http://www.anybus.com>, choose the link to the support page, select the Anybus-CompactCom product type and then your network type.

10.4 PROTOCOL IMPLEMENTATION

10.4.1 Definitions

In the protocol description we'll use the following definitions:

- Input field: is the set of master inputs that can be modified by the specific slave
- Output field: is the set of master outputs that can be read by the specific slave
- MaxInBytes: is the number of input bytes shared by the master and the specific slave
- MaxOutBytes: is the number of output bytes shared by the master and the specific slave
- IN[Nin] represent the input byte number Nin, where numbering starts from 0 to MaxInBytes-1
- OUT[Nout] represent the output byte number Nout, where numbering starts from 0 to MaxOutBytes-1

Obviously, MaxInBytes and MaxOutBytes are respectively the configured **INPUT** and **OUTPUT AREA** sizes.

The I/O Exchange Areas are actually updated and read every 30 ms at the Profinet Controller side. So after an RFID tag is read the worst delivery time from the Profinet Controller to the Master station is about 30 ms plus the intrinsic PROFINET IO delay and the Master delay.

This product implements the Datalogic AnyBus Driver (DAD) which is a layer that is built upon the intrinsic fieldbus data exchange mechanism. The Driver is needed to add features such as flow control and fragmentation.

In order to implement the flow controlled version of the driver, I/O Exchange Areas must be congruently compiled in both directions. **INPUT** Area is the Exchange buffer from Profinet Controller to the Master while **OUTPUT** Area is the exchange buffer from the Master to the Profinet Controller. Only the first three bytes are used by the Datalogic AnyBus Driver layer in both buffers for the extended protocol.

These are:

byte 0: **Control Field**, used to issue and control the Datalogic AnyBus Driver primitives such as flowcontrol, fragmentation and resynchronization;

byte 1: **Service Access Point Field**, used to distinguish among different services but also to provide future expandability. Since this SAP definition is introduced by the Datalogic AnyBus Driver, it must not be confused with the AnyBus SAP that is defined by the international standard.

byte 2: **Length Field**, that contains the number of bytes used by the application layer. This number must always be less than or equal to MaxInBytes-3 for the IN[] buffer and less than or equal to MaxOutBytes-3 for the OUT[] buffer.

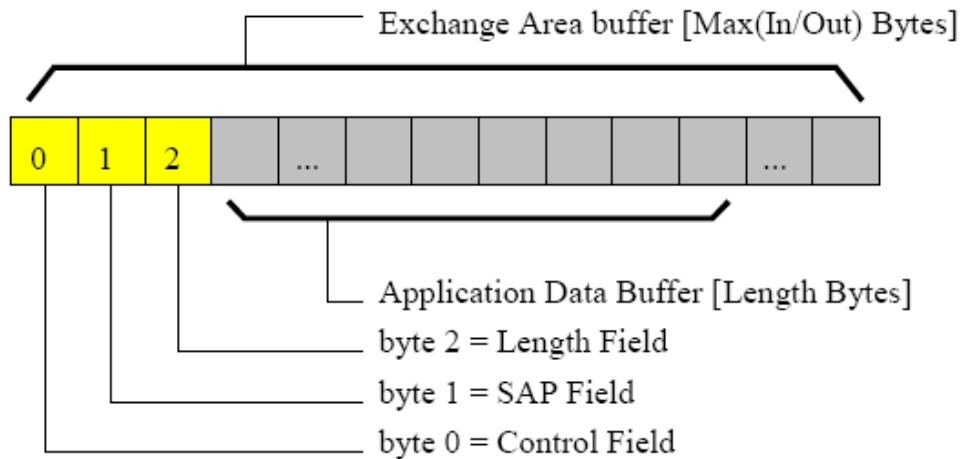


Figure 75 - Exchange Area Buffer Structure

10.4.2 Control Field

The Input field structure reserves IN[0] for handshake purposes: bit 0 and bit 1 are used for this. Bit 6 is set to 1 in order to specify the messaging protocol number 1 is in use. The Output field structure is symmetrical, and reserves bit 0 and 1 for handshake purposes. Bit 6 is set to 1 in order to specify the messaging protocol number 1 is in use. Bit 2 of the Output buffer is used to request a clear of the synchronization numbers (bit 0 and bit 1 of both Input and Output buffers).

This is called a resynchronization request and it is always initiated by the Master Station. The Slave must acknowledge the request, using bit 2 of the Input buffer. Bit 3 is used to control a fragmentation sequence in both directions.

More precisely,

function of the IN[0] byte:

IN[0].bit0 = TxBufferFull, toggles when new data is available on IN[1] .. IN[Nin] input area

IN[0].bit1 = RxBufferEmpty, toggles when rx block has been read on OUT[1] .. OUT[Nout]

IN[0].bit2 = Resync Acknowledge, set to 1 as an acknowledge to a resync request.

IN[0].bit3 = More Bit, it must be set to 1 when this is not the last piece of a fragmentation sequence. It must be set to 0 when this is the last piece of a fragmentation sequence.

IN[0].bit4,5,7 = set to 0,0,0 when this messaging protocol is used.

IN[0].bit6 = set to 1 when this messaging protocol is used.

function of the OUT[0] byte:

OUT[0].bit0 = TxBufferEmpty, toggles when transmitted data block has been read from master.

OUT[0].bit1 = RxBufferFull, toggles when new data block is available from master.

OUT[0].bit2 = Resync Request, set to 1 for 1 second to resynchronize a slave. After resynchronization, all 4 handshake bits are set to 0 and next toggle brings them to 1.

OUT[0].bit3 = More Bit, it must be set to 1 when this is not the last piece of a fragmentation sequence. It must be set to 0 when this is the last piece of a fragmentation sequence.

OUT[0].bit4,5,7 = set to 0,0,0 when this messaging protocol is used.

OUT[0].bit6 = set to 1 when this messaging protocol is used.

The following figure shows how it is possible to exchange messages with flow control using bit 0 and bit 1 in the IN/OUT buffers.

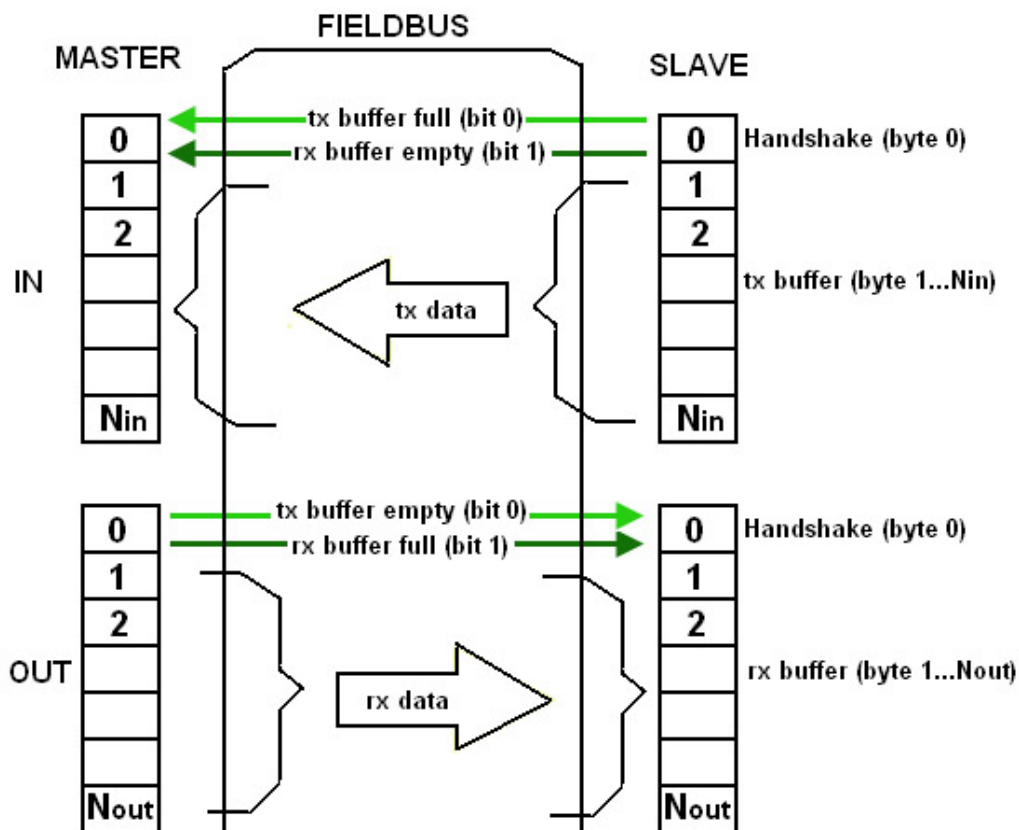


Figure 76 - Message Exchange with Flow Control

Data Transmission Slave → Master

The transmission state machine is shown to understand how a single block is transmitted and received. This protocol guarantees a basic flow control mechanism from slave to master.

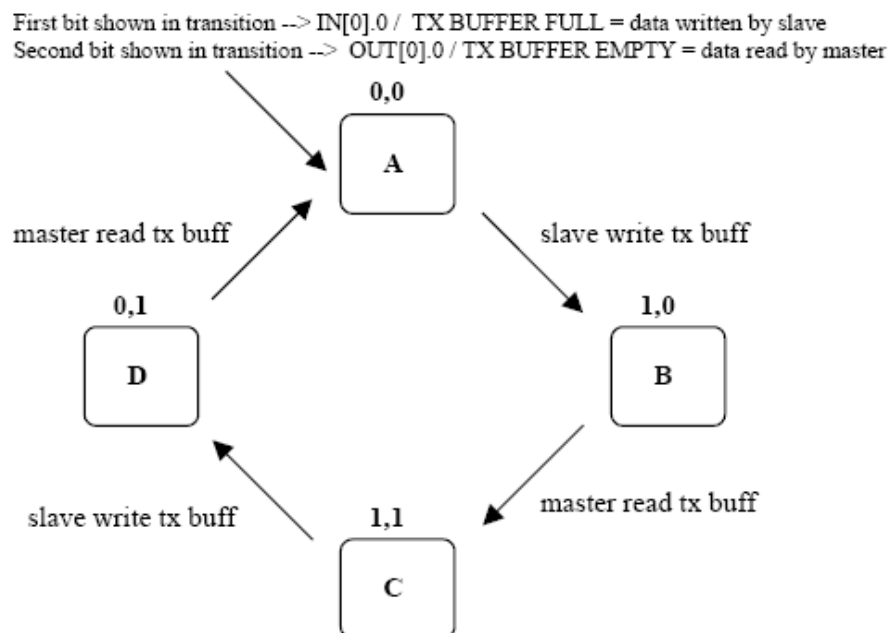


Figure 77 - Slave to Master Transmission State Machine

Data Transmission Master → Slave

The receive state machine is shown to understand how a single block is transmitted by the master and received by a slave. This protocol guarantees a basic flow control mechanism from master to slave.

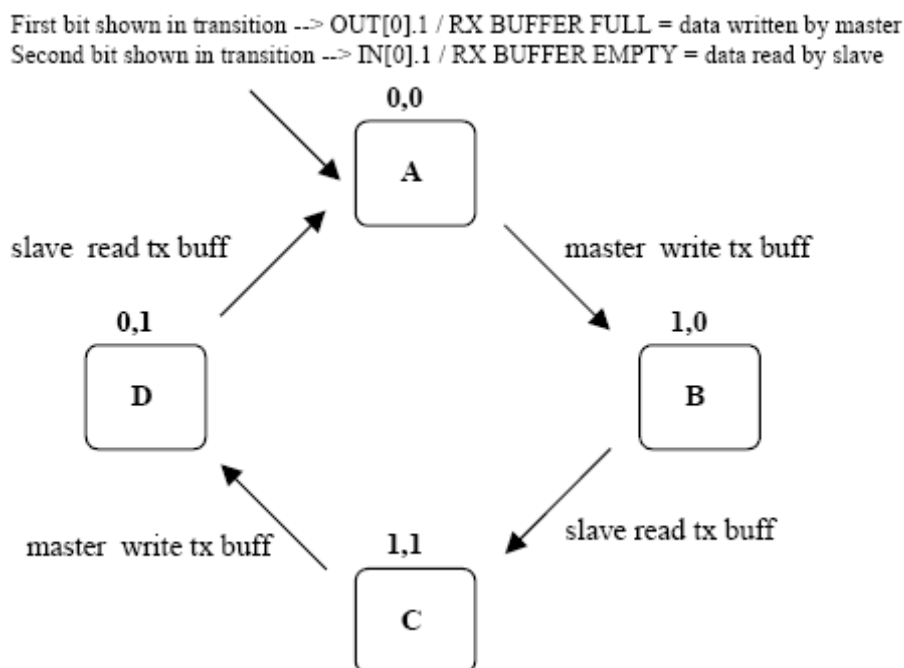


Figure 78 - Master to Slave Reception State Machine

Resynchronization Protocol

Resynchronization may be used at the master startup, both to detect if a slave is on line or not, or to restart the messaging protocol from a predefined state. It is also used during normal operations in case of errors requiring a protocol reset procedure to be started.

Bits order :

- OUT[0].bit2 = Sync request - IN[0].bit2 = Sync acknowledge

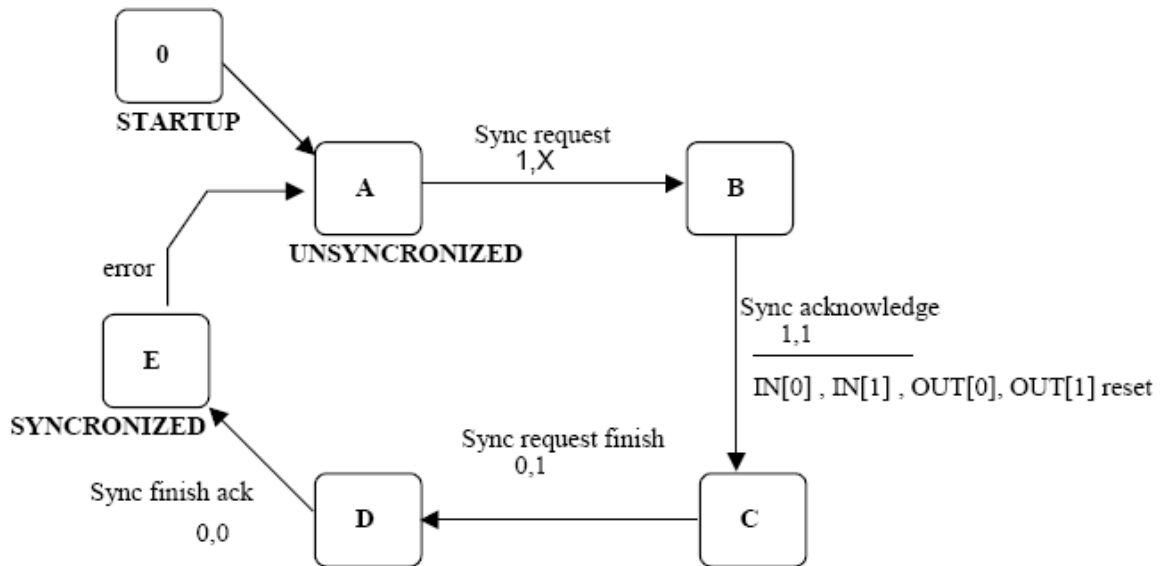


Figure 79 - Resynchronization State Machine

10.4.3 SAP Field

SAP (Service Access Point) is an identifier that is used to share the same communication channel between processes of two remote stations. This allows splitting the single service into different services.

SAP = 0 is actually used by the slave to transfer acquisition information; it should also be used to transfer application data from Master to Slave.

SAP = 2 is currently reserved.

SAP = 255 is currently reserved.

Only SAP 255 and 2 are reserved. All other SAPs are free and may be used by new application programs.

10.4.4 Length Field

The Application layer uses all or a part of the remaining bytes of the Exchange Area buffers that are not used by the Datalogic AnyBus Driver. The Length Field is introduced to keep the information of how many bytes are really used by the Application Layer. A fragment that is not the last one of a fragmentation sequence must fill this field with $\text{Max(In/Out)Bytes}-3$, depending on whether it is an INPUT/OUTPUT fragment. Otherwise this field is filled with a number that is less than or equal to $\text{Max(In/Out)Bytes}-3$.

10.4.5 Application Data Buffer

The Application data buffer holds the CBx commands described in the CBx Command Protocol Reference Manual.

10.5 EXAMPLES OF PROFNET COMMAND/RESPONSE MECHANISM

As seen in par. 10.3, there are two buffers – an OUTPUT Buffer that is controlled by the MASTER, and an INPUT Buffer that is controlled by the slave (the Controller).

The **OUTPUT Buffer** is mapped the following way:

Output Buffer	
Byte #	
00:	OUTPUT BUFFER CONTROL BYTE (OBCB)
01:	(Always 0)
02:	Packet Length in Bytes
03:	Packet Bytes (Command)
04:	" "
05:	" "
06:	" "
07:	" "
08:	" "
09:	" "
10:	" "
-	" "
-	" "
N-2:	" "
N-1:	Data Consistency Byte (OBDCB)

Byte 0 is the **Output Buffer Control Byte**. The Master uses the lowest two bits of this byte for handshaking: to signal that a command is ready for the slave (**Bit 1**), and to acknowledge receiving a response from the slave (**Bit 0**).

OUTPUT BUFFER CONTROL BYTE							
7	6	5	4	3	2	1	0
[1]	[0]	[0]	[0]	[0]	[0]	[0]	[0]

Bit 0 is toggled by the Master to acknowledge a packet (response) from the RFID Controller.

Bit 1 is toggled by the Master when it has a packet (command) ready for the RFID Controller.

Bit 2 is set when the Master wishes to initiate a “Resynchronization” with the Slave, and then cleared when it sees the corresponding handshake from the Slave, (indicating that the resynchronization is complete).

Bit 3 is set by the Slave when the total CBx response being returned to the Master is larger than the space available in the Input Buffer (or that the packet being returned is a fragment, and that there are more fragments to follow). This bit is cleared for the final fragment of a fragmented response – and so the Master can know when all the fragments of a response have been returned from the Slave.

Bit 7 is always 1, to conform to Datalogic's proprietary "DAD" Protocol.

Byte 1: is always 0.

Byte 2: contains the length of the packet in bytes (CBx Command or Command Fragment) to be sent to the RFID Controller. This can be the length of an entire CBx command, or the length of a fragment of a command, if the CBx command is larger than the space allowed to send it in a single fragment.

Byte 3 through Byte N-2 are used for the actual CBx Command or Command Fragment to be sent.

Byte N-1: the final byte of the Output Buffer is the **Data Consistency Byte**. It is a copy of the **Output Buffer Control Byte**. When changes to the Control Byte are made, the same changes must also be made in the Data Consistency Byte, before the changes "take effect". This is to guarantee the validity of the data between the two bytes.

The **INPUT Buffer** is controlled by the Slave (Cobalt RFID Controller) and is mapped the same way, except for the packet bytes containing a response (or response fragment) from the controller.

Input Buffer	
Byte #	
00:	INPUT BUFFER CONTROL BYTE (IBCB)
01:	(Always 0)
02:	Packet Length in Bytes
03:	Packet Bytes (Response)
04:	" "
05:	" "
06:	" "
07:	" "
08:	" "
09:	" "
10:	" "
-	" "
-	" "
N-2:	" "
N-1:	Data Consistency Byte (IBDCB)

Byte 0 is the **Input Buffer Control Byte**. The Slave uses the lowest four bits of this byte for handshaking: to acknowledge receiving a command from the master (Bit 1), and to signal that a response is ready for the master (Bit 0).

INPUT BUFFER CONTROL BYTE							
7	6	5	4	3	2	1	0
[1]	[0]	[0]	[0]	[0]	[0]	[0]	[0]

Bit 0 is toggled by the Slave when it has a new packet (response or response fragment) ready for the Master.

Bit 1 is toggled by the Slave to acknowledge a packet (command or command fragment) from the Master.

Bit 2 is set by the Slave after it completes resynchronization, and then cleared once the Master has acknowledged that resynchronization is complete.

Bit 3 is set by the Slave when the total CBx response being returned to the Master is larger than the space available in the Input Buffer (or that the packet being returned is a fragment, and that there are more fragments to follow). This bit is cleared for the final fragment of a fragmented response – and so the Master can know when all the fragments of a response have been returned from the Slave.

Bit 7 is set to 1 as soon as the Slave has been successfully initialized at power-up, and remains at 1, to conform to Datalogic's proprietary "DAD" Protocol.

Byte 1: is always 0.

Byte 2: contains the length of the packet in bytes (CBx response or response fragment) to be sent back to the Master.

Byte 3 through Byte N-2 are used for the actual CBx response or response fragment to be sent.

Byte N-1: The final byte of the Input Buffer is the Data Consistency Byte for the Input Buffer. It is a copy of the Input Buffer Control Byte. The Master should check that these two bytes are the same, before considering the Input Buffer's data to be valid.

**NOTE**

The combined total of the input and output buffers cannot exceed 248 bytes.

For specific exchange data examples, refer to the examples in par. 9.5, Profibus Interface.

11 TECHNICAL FEATURES

11.1 HF-SERIES CONTROLLER

ELECTRICAL FEATURES	
Supply Voltage	12 to 30 Vdc
DC Input Current max.	500 to 300 mA
Host Communication Interface:	
RS232	RS232
RS485	Subnet16™ (RS485)
IND	Ethernet IP, TCP/IP, MODBUS TCP
DNT	DeviceNet 125
PBS	Profibus –DP
PNT	Profinet IO
Digital Input (-12 models)	One optocoupled polarity insensitive digital input
Voltage Range	6 to 30 Vdc
DC Input Current max.	28 mA
Digital Outputs (-12 models)	Two optocoupled digital outputs
Voltage Range	6 to 30 Vdc
DC Output Current max.	external power: 500 mA per output; controller power: 300 mA total for both outputs
RADIO FEATURES	
Frequency	13.56 MHz
Air Protocols	ISO 14443A, ISO 15693
Conducted Output Power	1 W
ENVIRONMENTAL FEATURES	
Operating Temperature	-20° to +50 °C (-4° to +122 °F)
Storage Temperature	-20° to +70 °C (-4° to +158 °F)
Humidity max.	90% non condensing
Protection Class EN 60529	IP65
PHYSICAL FEATURES	
Dimensions:	
RS232, RS485, IND	137 x 112 x 48 mm (5.40 x 4.41 x 1.88 in)
DNT, PBS, PNT	164 x 112 x 48 mm (6.48 x 4.41 x 1.88 in)
Weight:	
RS232, RS485, IND	440 g (15.5 oz)
DNT, PBS, PNT	560 g (19.8 oz)
USER INTERFACE	
LED Indicators:	
RS232	READY, RF, COM
RS485	READY, RF, COM, NODE ID
IND	READY, RF, COM, DEFAULT IP, CUSTOM IP
DNT	READY, RF, COM, DEVICENET
PBS	READY, RF, COM, STATUS, OP MODE
PNT	READY, RF, COM, NET STATUS, MODE STATUS, LINK 1; LINK 2

The features given are typical at a 25 °C ambient temperature (if not otherwise indicated).

11.2 HF-SERIES ANTENNAS

RADIO FEATURES	
Frequency	13.56 MHz
Input Impedance	50 ohms
Gain:	
HF-ANT-0750-1	-37.8 dBi
HF-ANT-1010-1	-36.6 dBi
HF-ANT-2020-1	-26.3 dBi
HF-ANT-3030-1	-22.9 dBi
Conducted Input Power	1 W
ENVIRONMENTAL FEATURES	
Operating Temperature	-20° to +50 °C (-4° to +122 °F)
Storage Temperature	-20° to +70 °C (-4° to +158 °F)
Humidity max.	90% non condensing
Protection Class EN 60529	IP65 (when correctly mounted)
PHYSICAL FEATURES	
HF-ANT-0750-1	
Dimensions	70 x 500 x 40 mm (2.76 x 19.69 x 1.57 in)
Weight	635 g (22.4 oz)
HF-ANT-1010-1	
Dimensions	100 x 100 x 42 mm (3.94 x 3.94 x 1.67 in)
Weight	280 g (9.88 oz)
HF-ANT-2020-1	
Dimensions	200 x 200 x 42 mm (7.87 x 7.87 x 1.67 in)
Weight	500 g (17.64 oz)
HF-ANT-3030-1	
Dimensions	300 x 300 x 42 mm (11.81 x 11.81 x 1.67 in)
Weight	740 g (26.10 oz)

The HF-CNTL-xxx-x2 Controller and its antenna are intended for indoor use only.

A RFID OPERATING PRINCIPLES

RFID OVERVIEW

Cobalt HF-Series products are designed for use with passive RFID tags, which do not require batteries or contain an internal power supply. Through a process called **inductive coupling**, passive RFID tags obtain power from the RFID antenna.

When a passive tag comes in contact with the RF field from an RFID antenna, the incoming radio frequency signal generates a small, but sufficient, electrical current that powers the passive tag's integrated circuit (IC) and antenna.

Similar to a transformer, the efficiency of the energy transferred is directly related to the size and number of turns of the transmitting antenna (primary winding) and the size and number of turns of the RFID tag's antenna (secondary winding). The resonant frequency and Q-factor (quality factor) of each antenna coil are the primary concerns when producing efficient antenna coil and tag coil designs. The Q-factor defines how broad the energy bandwidth is spread.

Antenna and tag coils that are optimally tuned will achieve the most efficient energy transfer. Although, RF output power is fixed within legal limits, the higher the peak energy at the resonant frequency, the higher the Q-factor value and the narrower the bandwidth. Inversely, the lower the peak energy at the resonant frequency, the lower the Q-factor value (resulting in a wider bandwidth). In general, raising the Q-factor value of the two antenna coils produces better overall range results. However, when the Q-factor value becomes too high, the system may become less tolerant to shifts in resonant frequency. When the Q-factor is low, bandwidth becomes wider which increases system tolerance to a shift in resonant frequency.

Tuned antenna circuits can be affected by many materials. Metal, liquid, plastic, cement and even organic substances can cause an upward shift in the resonant frequency, which can negatively affect an antenna's tuning (certain other materials can cause a downward shift in resonant frequency as well). However, the lower the operating frequency, the less pronounced the influence would be to the antenna's performance. Cobalt HF-Series products are manufactured using optimal antenna designs that exhibit Q-factor values within the required range of most applications.

Cobalt Controllers operate at the internationally accepted ISM (*Industrial, Scientific and Medical*) frequency of 13.56 MHz. Residing in the High Frequency RF spectrum, 13.56 MHz provides an excellent compromise between range, speed and immunity to environmental materials, as opposed to 864 MHz or 915 MHz, which fall under the Ultra-High Frequency (UHF) spectrum or 2.4GHz, which resides in the microwave range spectrum. For reference, 13.56 MHz falls between the AM and FM radio bands.

When mounting RFID antennas and tags, it is important to understand certain principals. If your RFID application requires that the tag be attached directly to a metal surface, always use a non-metallic tag spacer to avoid a possible reduction in read/write range.

In addition, motors, conveyors and other automation equipment can produce excessive electrical noise that may also negatively affect RF performance. Cobalt HF-Series products should only be used with well-grounded systems. Conveyor equipment should be tied directly to an earth ground by an electrician. All cables used on or around Cobalt HF RFID devices must be shielded. Cable shields typically should be grounded at only one end.

The majority of the *Antenna-to-Tag* range results specified in this publication were calculated in a free air environment – where no metallic objects were within the antenna's RF field. Yet because proximity to metals and other environmental conditions can adversely affect read and write range, it is not possible to state absolute range results achieved under all conditions. System integrators should validate the RF performance of the RFID products used and should not rely solely on Datalogic published range specifications.

The Cobalt HF RFID Controller is compatible with Datalogic **HMS-Series** and **LRP-Series** RFID tags. HMS-Series tags utilize integrated circuits (ICs) compliant with ISO 14443A standards. LRP-Series tags, which provide a greater potential read/write range, employ integrated circuits compliant with ISO 15693 specifications, and include NXP's I-CODE SLI (SL2) and tag ICs manufactured by Fujitsu and Infineon.

SUBNET16™ MULTIDROP PROTOCOL

The **HF-CNTL-485-02** model includes support for Datalogic **Subnet16™** Multidrop RFID networking protocol. Under the Subnet16 protocol, up to 16 HF-CNTL-485-x2 controllers can be connected via a trunk and tap network to a Subnet16™ Industrial Gateway (GWY-01-xxx-01) for connections to a variety of Fielbus or TCP/IP networks.

HF-CNTL-485-x2 models can also be connected directly to a Subnet16™ Industrial Hub (HUB-04-IND-01) or Subnet16 TCP/IP Hub (HUB-04-TCP-01). Subnet16 Hubs possess four independent controller ports, four digital inputs and four digital outputs.

DATALOGIC RFID TAGS

As of this publication, Datalogic tags containing the RFID integrated circuits (ICs) listed below are compatible with Cobalt HF Controllers.

HMS-Series RFID Tags

Datalogic HMS-Series RFID tags use the following integrated circuits:

NXP Mifare Classic - 1 kilobyte (kB) + 32-bit Tag ID (ISO 14443A): One KB is the total memory in the IC. Of this memory, 736 bytes are available for user data.

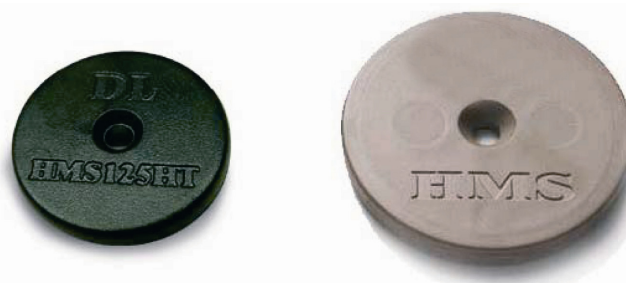


Figure 80 - HMS125HT and HMS150HT RFID Tags

LRP- and T-Series RFID Tags

Datalogic LRP- and T-Series RFID tags use the following integrated circuits:

- NXP I-CODE SLI, 112-byte + 64-bit Tag ID (LRP-S Series; ISO 15693)
- Infineon My-D Vicinity, 1 kb + 64-bit Tag ID (LRP-I Series; ISO 15693)
- Fujitsu, 2 kB + 64-bit Tag ID (T Series; ISO 15693)

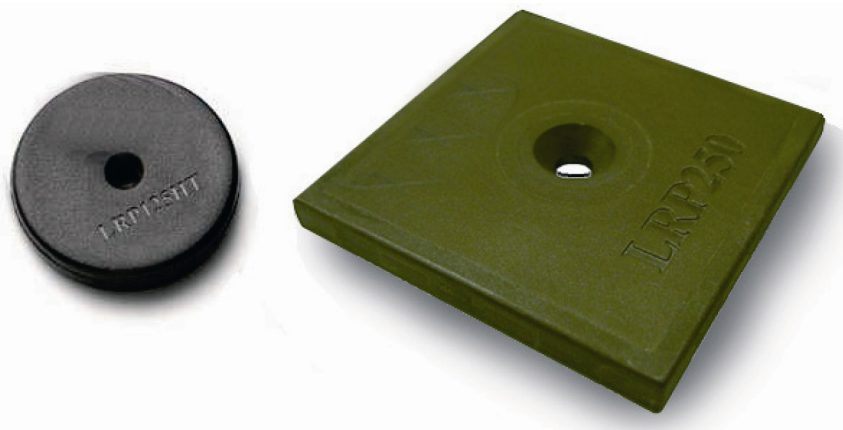


Figure 81 - LRP125 and LRP250 RFID Tags

RFID TAG STANDARDS

RFID tags, which are also referred to as RFID transponders, smart labels, or inlays, are produced in a variety of sizes, memory capacities, read ranges, frequencies, temperature survivability ranges and physical embodiments.

Datalogic offers many different RFID tag models. Cobalt Controllers are capable of reading all Datalogic HMS and LRP-Series RFID tags as well as most of those produced by other manufacturers.

Our patented tags can be read through obstructions such as water, wood, plastic and more. Our specialty high-temperature (HT) models are capable of surviving temperatures of 415° F.

It is important to note that not all 13.56MHz RFID tags are compatible with Cobalt Controllers and even tags that are said to be compliant with ISO standards may not actually be compatible with RFID controllers adhering to the same standards. This is partially due to ISO standards so new that they leave many features open to the discretion and interpretation of the RFID equipment manufacturer to implement or define. When using another manufacturer's tags, ensure compatibility of those tags with your RFID system provider.

ISO 14443A

RFID integrated circuits (ICs) designed to meet ISO 14443A standards were originally intended for use in smart cards used in secure transactions such as credit cards, passports, bus passes, ski lift tickets, etc. For this reason there are many security authentication measures taken within the air protocol between the RFID device and the tag. Datalogic was the first company to adopt ISO 14443 RFID ICs with this technology for industrial automation

applications. Because these applications do not require the level of security monetary or passport applications require, many of these features have not been implemented in HF-Series products. It is important to understand the requirements of an ISO 14443 application before assuming an HF-Series reader/writer is suitable.

ISO 14443A compliant tags and controllers incorporate security authentication through the exchanging of software “keys.” The RFID controller and the tag must use the same security keys to authenticate communication before the transfer of data will begin. The Cobalt Controller’s operating system manages these security features, making their existence transparent to the user. However, it is important to understand the implications associated with ISO 14443 when using another manufacturer’s RFID tags. Because of these security “features,” an ISO 14443 tag made by one manufacturer may not necessarily be readable by a Cobalt Controller and, likewise, an Datalogic ISO 14443 compliant tag might not be readable by another manufacturer’s RFID controller. The Cobalt Controllers support Datalogic security keys for use on NXP Mifare ISO 14443A tags.

Datalogic was one of the first companies to adopt ISO 14443 standards and has incorporated much of the technology into our products designed for industrial automation applications. But because most industrial environments do not require the same level of security monetary or passport applications necessitate, some features have not been implemented in the Cobalt HF product line.

ISO 15693

ISO 15693 was established at a time when the RFID industry identified that the lack of standards was preventing the market from growing. NXP Semiconductor and Texas Instruments were, at that time, the major manufacturers producing RFID ICs for the *Industrial, Scientific, and Medical* (ISM) frequency of 13.56MHz. However, each had their own unique protocol and modulation algorithm. NXP Semiconductor’s I-CODE® and Texas Instruments Tag-it® product lines were eventually standardized on the mutually compatible ISO 15693 standards. After the decision was made to standardize, the door was opened for other silicon manufacturers to enter the RFID business, many of which have since contributed to other RFID ISO definitions. This healthy competition has led to rapid growth in the RFID industry and has pushed the development of new standards, such as ISO 180x000 for *Electronic Product Code* (EPC) applications.



NOTE

Many factors can affect the read/write performance between an RFID controller’s antenna and a tag’s antenna. These include, but are not limited to, the tag’s integrated circuit (IC), the tag’s antenna coil design, the tag’s antenna conductor material and coil substrate, the bonding method between tag IC and antenna coil, and the material used to embody the tag.

Additionally, the mounting environment of the tag and the controller can hinder performance due to the presence of other materials (particularly metals) that affect the tuning of either antenna. Datalogic has performed extensive testing in order to produce tags that obtain optimum performance with our RFID products. In most cases, optimal range will be obtained when mounting the tag and the controller/antenna in locations free of metals and the influence of ESD and EMI emitting devices.

RFID TAG EMBODIMENTS

RFID tags are designed, produced and distributed in a variety of sizes and packages.

Printed Circuit Board RFID Tags

RFID tags that incorporate Printed Circuit Board (PCB) technology are designed for encasement inside totes, pallets, or products that can provide the protection normally associated with injection-molded enclosures.

These tags are made primarily from etched copper PCB materials (FR-4, for example) and are die-bonded by means of high quality wire bonding.

This procedure ensures reliable electrical connections that are superior to flip-chip assembly methods. The RFID tag's integrated circuit is then encapsulated in epoxy to protect it and the electrical connections.

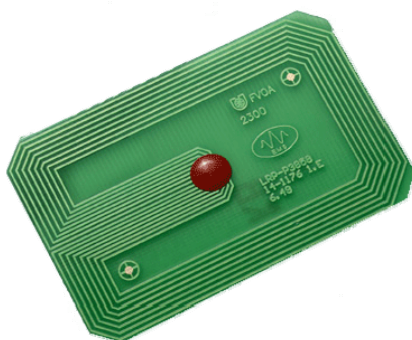


Figure 82 -Printed Circuit Board RFID Tags

Molded RFID Tags

Molded tags, which are PCB tags that have been protected with a durable resin overmolding, are the most rugged and reliable type of tag offered by Datalogic. These tags are designed for closed loop applications where the tag is reused; thereby the cost of the tag can be amortized over the life of the production line.

Typically, molded tags will be mounted to a pallet or carrier, which transports the product throughout the production process. Some of the applications for these tags include, but are not limited to, embedding the tag into concrete floors for location identification by forklifts and automatically guided vehicles (AGVs), shelf identification for storage and retrieval systems, and tool identification.

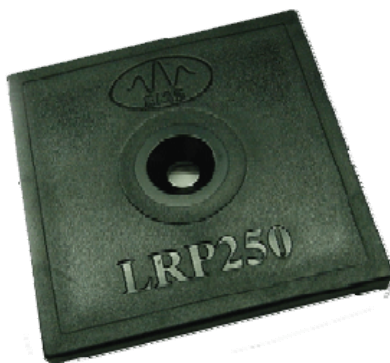


Figure 83 -Molded RFID Tags

High temperature (HT) tags, using patented processes and specialized materials, allow tags to survive elevated temperatures, such as those found in automotive paint and plating applications. Datalogic offers a wide variety of molded tags that have been developed over the years for real world applications.

RFID TAG MEMORY

RFID Tag memory addressing typically begins at tag address zero (0x00), with the highest addressable memory location equal to one less than the total number of bytes in the tag. Each address location is equal to one byte (8-bits), where the byte is the smallest addressable unit of data. So for example, writing 8-bytes to a tag beginning at address 0x00 will actually fill addresses 0x00 through 0x07 with 64-bits of data in all.

Depending on the manufacturer, RFID labels, molded tags and embedded PCBs can have differing memory storage capacities and organization. Tag memory is grouped into blocks of bytes that can vary in structure from manufacturer to manufacturer. Even when compliant to ISO standards, byte memory addressing can differ from one manufacturer to another. For example, tag memory can be organized in blocks of 4 or 8 bytes, depending on the RFID IC. Additionally, all bytes may not be available for data storage as some bytes may be used for security and access conditions.

Datalogic has taken great care to simplify tag memory addressing. The mapping from logical address to physical address is handled by the Cobalt Controller's operating system. Users only need to indicate the starting address location on the tag and the number of bytes to be read or written.

Mapping Tag Memory

Creating a Tag Memory Map is much like designing a spreadsheet that outlines the actual data you plan to capture as well as the specific tag memory locations in which you wish to store said data. Tag Memory maps should be carefully planned, simple and straightforward. It is advisable to allow additional memory space than is initially required, as inevitably a need will arise to store more data.

In the example below, 90-bytes of a 112-byte tag have been allocated to areas of the Memory Map (leaving roughly 20% free for future uses). Because a short paragraph of alphanumeric characters could quickly use all 90 bytes, creating an efficient mapping scheme that utilizes all 720-bits (out of the 90-bytes allocated) will provide a better use of tag space.

Tag Memory Map Example

Tag Address	Usage
00 – 15	Serial Number
16 - 47	Model Number
48 - 63	Manufacturing Date
64 - 71	Lot Number
72 - 89	Factory ID
90 - 111	Reserved for future use

Optimizing Tag Memory

Data is stored in tag memory in binary format (1's and 0's). Binary numbers are notated using the hexadecimal numbering system (otherwise, users would be forced to interpret long strings of 1's and 0's).

Below is an example of how hexadecimal notation simplifies the expressing of byte values for the decimal number 52,882. Instead of using 5-bytes of data to store the ASCII bytes representing characters 5, 2, 8, 8, and 2 (ASCII bytes: 0x35, 0x32, 0x38, 0x38, 0x32) by simply writing two "hex" bytes (0xCE and 0x92), 60% less tag memory is used to store the same information.

Decimal	Binary	Hexadecimal
52,882	1100111010010010	CE92

When an alphabetical character is to be written to a tag, the Hex equivalent of the ASCII value is written to the tag. So for example, to write a capital "D" (ASCII value 0x44), the Hex value 0x44 is written to the tag.

In addition, when a database with look up values is used in the RFID application, the logic level of the individual bits within the tag can be used to maximize tag memory even further.



The graphic below illustrates how a single byte (8-bits) can be efficiently used to track an automobile's inspection history at eight inspection stations. The number one (1) represents a required operation and the number zero (0) represents an operation that is not required for that particular vehicle.

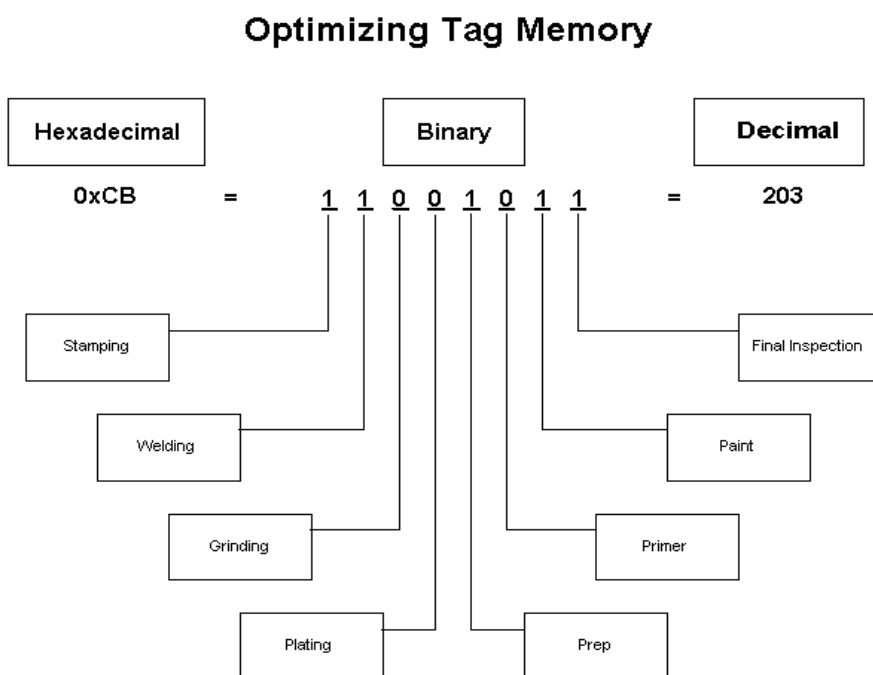


Figure 84 - RFID Tag Memory Optimization

**Datalogic Automation S.r.l.**

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www.automation.datalogic.com*declares that the*

HF-CNTL-232; RF-ID Controller
HF-CNTL-485; RF-ID Controller
HF-CNTL-IND; RF-ID Controller
HF-CNTL-PBS; RF-ID Controller
HF-CNTL-DNT; RF-ID Controller
HF-CNTL-PNT; RF-ID Controller

*and all its models**are in conformity with the requirements of the European Council Directives listed below:***1999 / 5 / EEC R&TTE***This Declaration is based upon compliance of the products to the following standards:***ETSI EN 301 489-3 V1.4.1, AUGUST 2002 :**

ELECTROMAGNETIC COMPATIBILITY AND RADIO SPECTRUM
MATTERS (ERM); ELECTROMAGNETIC COMPATIBILITY (EMC)
STANDARD FOR RADIO EQUIPMENT AND SERVICES; PART 3:
SPECIFIC CONDITIONS FOR SHORT-RANGE DEVICES (SRD)
OPERATING ON FREQUENCIES BETWEEN 9KHZ AND 40GHZ

ETSI EN 300 330-2 V1.3.1, APRIL 2006 :

ELECTROMAGNETIC COMPATIBILITY AND RADIO SPECTRUM
MATTERS (ERM); SHORT RANGE DEVICES (SRD); RADIO
EQUIPMENT IN THE FREQUENCY RANGE 9 KHZ TO 25 MHZ AND
INDUCTIVE LOOP SYSTEMS IN THE FREQUENCY RANGE 9 KHZ
TO 30 MHZ; PART 2: HARMONIZED EN UNDER ARTICLE 3.2 OF
THE R&TTE DIRECTIVE

EN 60950-1, APRIL 2006 :

INFORMATION TECHNOLOGY EQUIPMENT - SAFETY -
PART 1 : GENERAL REQUIREMENTS

EN 60950-1/A11, MARCH 2009 :

Monte San Pietro, June 29th, 2011

Lorenzo Girotti
Product & Process Quality Manager

